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ABSTRACT

A developmental project created prototype individualized instructional materials for the Inventory Management (IM) Course which could be incorporated into the Air Force Advanced Instructional System (AIS). Typical course segments and a final block of instruction were selected, and instructional materials were developed for these units. The materials were field-tested with individual students and revised; they were then used with a group of students, revised a second time, and used by several Air Force training classes. Results showed that all students attained all the learning objectives, and that a mean student time savings of 55% was achieved. Student attitudes were favorable and no problems were encountered. It was therefore concluded that the individualized materials should be used in the AIS since they resulted in increased efficiency with no loss of achievement. (Author/PB)

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AIR FORCE HUMAN RESOURCES LABORATORY

AFHRL-TR-74-17

ADVANCED DEVELOPMENT WORK RESULTING IN INVENTORY MANAGEMENT (IM) INDIVIDUALIZED INSTRUCTION MATERIALS

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February 1974
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MARTY R. ROCKWAY, Technical Director
Technical Training Division

Approved for publication.

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This report describes a study to develop prototype individualized instructional materials and identify potential problems for the Inventory Management Course as part of the Advanced Instructional System. Typical course segments and a final block of instruction were selected and instructional materials were developed for these segments. The materials were tried in the classroom by the contractor on an individual basis and then with a group of students. The materials were revised as required. The materials were then tried out on several classes by the Air Force. All students attained all learning objectives. A mean student time savings of 55% was achieved during the AF trials. No major problems were encountered. Student attitudes toward the materials and methods were highly favorable.

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SUMMARY

Problem.

The purposes of this study were to: (1) select 30 representative instructional hours from Blocks I, II, and III of the IM Course that typify those blocks; (2) develop individualized instructional materials for those 30 hours as well as the entire Block IV (60 hours) of the course; (3) try out and evaluate the materials; and (4) document the results, problems involved, and processes used to develop the materials. This study is part of a larger project, the Advanced Instructional System (AIS). The problem identification and prototype materials development were directed toward the AIS.

Approach.

The IM Course was analyzed and typical segments were selected from Blocks I, II, and III. As a result of the analysis, instructional media and strategies were selected, and materials were developed for these segments as well as for Block IV. The materials were tried out initially on one or two individuals and revisions made as required. The materials were then tried out on a classroom of students. Normal AF routines were followed as much as possible. All students were given criterion referenced tests during the block and an end of block multiple choice test. Final revisions based on this validation group were then made.

Results.

The 20 students in the tryout passed all criterion referenced tests and achieved a mean block time savings of 47%. Their mean block grade was 82.8%. An additional group of 57 students used the revised materials. They also passed all criterion reference tests with a mean time savings of 55%, and a mean end of block test score of 88.6%. Student attitudes toward the learning materials and methods were highly favorable. No major problems were encountered.

Conclusions.

The instructional materials resulted in improved student efficiency with no loss of achievement. Student attitudes toward individualized instruction were favorable. No significant problems were uncovered to pose any threat to the AIS.

This summary was prepared by Arnold L. Hanson, Technical Training Division, Air Force Human Resources Laboratory

PREFACE

This report was submitted by the System Development Corporation, Santa Monica, California, under Contract F33615-71-C-1813, Project 1193/0B/03, with the Technical Training Division, Air Force Human Resources Laboratory, Lowry Air Force Base, Colorado. Mr. Bradley Fallentine was the principal investigator, Mr. Larry Harris was the senior investigator, Mr. Arnold L. Hanson was the contract monitor, and Mr. Joseph Yasutake was the project scientist.

The study was performed in cooperation with the USAF School of Applied Sciences, Lowry Air Force Base, Colorado. Mr. James W. Hilliard was the Lowry Air Force Base project monitor. Among the many other Lowry school personnel who directly contributed to the project were Mrs. Louise Maxey, Mrs. Virginia Johnson, SMSgt Johnny Whitson, MSgt Preston Baker, TSgt William Morales, TSgt Ronald Eberhardt, TSgt Sell Beverly, Jr., SSgt Charles Goodman, SSgt Stanley Powers, SSgt Ronald L. Babb, SSgt Richard R. Gab, SSgt James Erkhart, and SSgt Edward L. David. The authors also wish to thank Mr. Joseph Lamos of the Technical Training Division for his thorough and detailed review of this report.

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INTRODUCTION

PROJECT BACKGROUND

The IM Project is part of a larger project, the Advanced Instructional System (AIS). The AIS will be a large scale, computer-based instructional system used for Air Force training and education. The AIS will be an integrated training system encompassing course material, instructional media, and a training management system. Initial effort is currently underway to develop prototype instructional materials for three targeted Air Training Command (ATC) courses which can be converted to run under the AIS. The IM Specialist course is one of these courses.

The purpose of the IM Project is to: (a) select 30 instructional hours of course material from Block I, II and III of the IM course which are representative of the segments in these blocks, (b) develop individualized instructional materials in support of the 30 instructional hours and also for the last 60 hours of the course, and (3) try out and evaluate these materials. The project consists of the following four phases: (1) analysis of the IM course and selection of course segments, (2) analysis of course segments and selection of media and instructional strategy, (3) preparation of instructional materials, (4) try out and evaluation of instructional materials.

Of particualr importance for the IM Project is the development of prototype course materials which can be converted into a full-scale, computer-managed system. Therefore, the analysis of the IM course and the resulting selection of course segments considered this factor as well as the usability of course materials prior to operating under the AIS.

OVERVIEW OF THE INSTRUCTIONAL MATERIALS DEVELOPMENT PROCESS

The IM Project required System Development Corporation (SDC) to select segments of the existing IM course for which individualized (self-paced) instruction would be appropriate and to develop individualized instructional materials for these segments. In addition, SDC was to develop a strategy whereby the modified course could be managed, and to provide cost information and cost estimates for a course materials production configuration. Since the new course materials and management system are to be converted to use in a computerized instructional system at a later date, SDC was required to provide material and management plans that are computer-compatible. SDC has developed a step-by-step process for accomplishing these kind of tasks. That process, as it was applied to the IM Project, is described in this part.

A graphic overview of the development process is provided in Figure 1. Each box in this figure is explained in detail in the text which follows.

TRAINING CONCEPT

SDC began the IM Project with a generalized training concept applicable to all types of training courses which have the basic objective of teaching performance of a job. The basic principles of this concept are as follows:

> Trainees should be required to perform tasks in accordance with the on-the-job procedure.
>
> Theory and terminology (as opposed to hands-on-task performance) will be taught along with related practical tasks.
>
> Tests should cause students to demonstrate job-related skills rather than, or in addition to, "knowledge about the job".
>
> Instructional material should be sequenced in the order in which tasks and subtasks are performed on-the-job whenever possible.

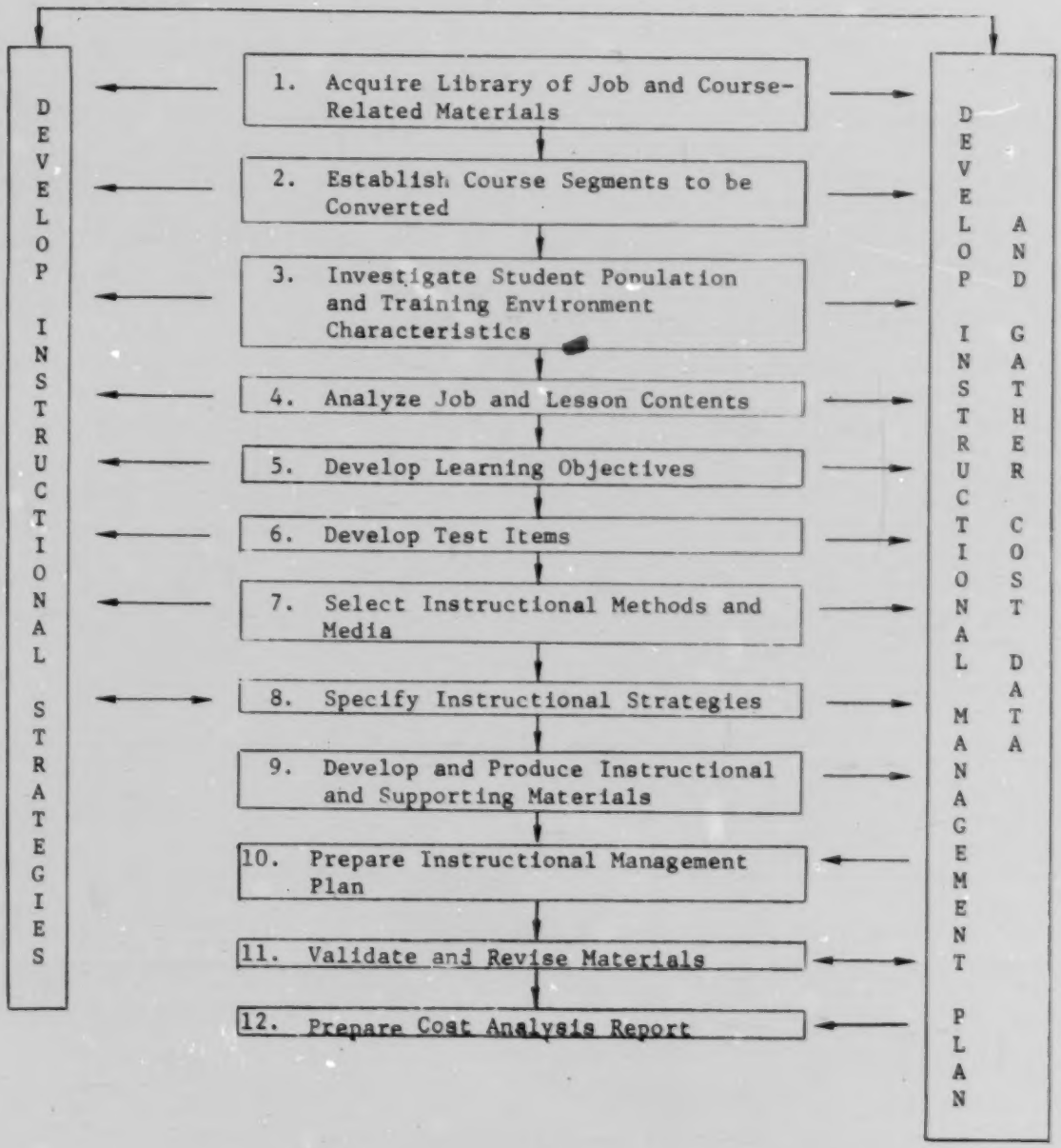

DEVELOP INSTRUCTIONAL STRATEGIES
1. Acquire Library of Job and Course-Related Materials
2. Establish Course Segments to be Converted
3. Investigate Student Population and Training Environment Characteristics
4. Analyze Job and Lesson Contents
5. Develop Learning Objectives
6. Develop Test Items
7. Select Instructional Methods and Media
8. Specify Instructional Strategies
9. Develop and Produce Instructional and Supporting Materials
10. Prepare Instructional Management Plan
11. Validate and Revise Materials
12. Prepare Cost Analysis Report
DEVELOP AND GATHER COST DATA INSTRUCTIONAL MANAGEMENT PLAN

Figure 1. Overview of Instructional Materials Development Process

STEPS IN THE DEVELOPMENT PROCESS

This report describes each step in the instructional materials development process for the IM course. For each step in the process, there is a section of text.

At the beginning of each section of text, there is a flow chart showing the substeps of that step. Each second-level flow chart begins with the box for that step, as shown in Figure 1, and ends with the box for the next step. These two boxes, beginning and end, are drawn with heavy lines, as shown in Figure 2.

STEP 1: ACQUIRE A LIBRARY OF JOB AND COURSE MATERIALS

The first step in the development of instructional materials is to acquire job and course documentation and develop a filing and referencing system for it (see Figure 2).

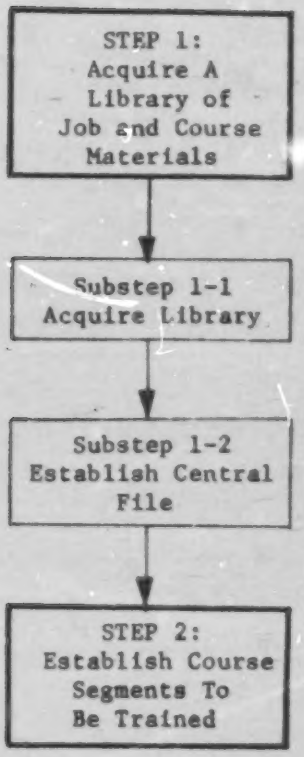


Figure 2. Substeps in Acquiring a Library of all Job and Course Materials

SUBSTEP 1-1. ACQUIRE LIBRARY

For the IM Project library, SDC acquired the following types of materials related to the existing IM course and to the IM Specialist's job:

- Speciality training standard
- Course charts
- Plan of instruction
- Student study guides
- Student workbooks
- IM occupational survey report
- Lesson plans
- Programmed texts
- Student handouts
- Materials and documents used on-the-job
- Performance tests and within tests
- Applicable Air Force Regulations
- Course audiovisual materials

The specialty training standard, lesson plans, student study guides and workbook proved to be most useful in developing instructional materials. The Occupational Survey Report is normally an excellent guide to the tasks that are performed on-the-job; however the Report for Inventory Management was outdated.

SUBSTEP 1-2. ESTABLISH CENTRAL FILE

All materials were filed using a simple numerical filing scheme, and a central file index list was prepared. The central file index list is located in Appendix A.

STEP 2: ESTABLISH COURSE SEGMENTS TO BE TRAINED

SDC was requested to select 30 hours of instruction from the existing IM course of 240 hours and to provide individualized instructional materials for those 30 hours and also for the last 60 hours of the course. (Figure 3 presents Step 2 and its Substeps.)

The 30 hours selected were to meet the following requirements:

- Conversion to individualized instruction must not increase the number of instructors or instructor hours required.
- Segments selected must be representative of the course as a whole with respect to skills, knowledges and media requirements.
- Segments selected must have content such that individualized instructional materials developed for them could be readily adapted to computer assisted instruction and/or a computer-managed course.

When good course documentation is not available as a base from which to select segments for individualized instruction, developers must work directly from a job/task data base. The job itself, and all the tasks performed in the course of the job, must be analyzed in order to select tasks requiring training and to establish the suitability of individualized instructional techniques for training each task. In addition, required characteristics of trainees, both for the job and for the course, must be established from a thorough job/task analysis. For the IM Project, the lengthy process of establishing such a data base and performing the analysis was not necessary. Existing course materials and interviews with instructors and subject matter experts provided a sufficient basis for the selection of course segments for individualized instruction.

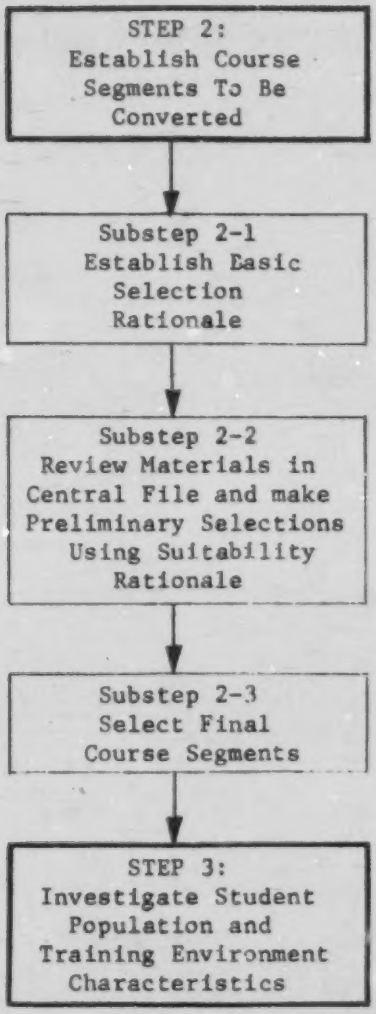


Figure 3. Substeps in Establishing Job Segments to be Converted to Individualized Instruction

SUBSTEP 2-1. ESTABLISH BASIC SELECTION RATIONALE

SDC developed a three-stage selection rationale for the IM course. For Stage One, three variables were considered in developing a list of lessons potentially suitable for conversion to individualized instruction, namely:

- Proficiency levels required to be attained in the course as specified in STS645XC.
- Average percentage of time spent doing a given task on the job as derived from the IM occupational survey report.
- Lesson effectivity, estimated for the effect that conversion to individualized instruction would have on student performance. (Estimations were based on such factors as lack of need for student interaction to perform a task, estimated cost of production of learning aids, and enhancement of student performance, particularly for task-oriented subject matter.)

A scoring system was devised in which each existing lesson was assigned a score of zero, one, or two on each of the three variables. Lesson segments with a score of two for each variable were selected for the initial list of potential individualized course segments.

For Stage Two, SDC evaluated the potential candidates selected in Stage One on the basis of total skill and knowledge requirements as it had been requested that the segments selected be representative of the course as a whole in terms of skills and knowledges. Segments with similar skills and knowledge requirements were identified, overlapping areas of these requirements eliminated, and an abbreviated list of segments totaling 30 to 40 course hours and meeting these requirements was developed.

During Stage Three, a final determination was made on the following criteria:

- Lack of dependence of selected segments on unselected segments
- Logical interrelationship of selected segments
- Representative requirements for media

Other rationales can be used for the selection process, depending on the quantity and quality of existing course materials and upon course objectives. One useful cue for considering course segments for individualized instruction is that of low test scores which may indicate trainee difficulty in learning the course material. When students, over a period of time, have difficulty with a particular course unit or segment, individualized instructional techniques may improve student performance if materials are well designed. Instructional materials developers can use student test scores to determine which course units are most difficult, particularly for the best students.

SUBSTEP 2-2. REVIEW MATERIALS IN CENTRAL FILE AND MAKE PRELIMINARY SELECTIONS

Each lesson plan in the central file was analyzed and scored using the Stage One selection rationale. Figure 4 shows the score sheet; explanations of the scoring appear at the bottom. The score sheet itself shows the source of the information used to assign a score. All lesson plans with average scores of two were selected as potential lessons for conversion. There were 44 course hours in this list. The Stage Two selection rationale was then applied to the 44-hour list, resulting in the omission of 12 course hours (3 lessons) due to their similarity in skill and knowledge requirements to other selected segments. Preliminary selections are shown in Tables 1 and 2.

1	2	3			4	5	6
BLOCK III - STOCK CONTROL	HOURS	STS 645X0 TASK PERFORMANCE LEVEL	STS 645X0 TASK KNOWLEDGE LEVEL	STS 645X0 SUBJECT KNOWLEDGE LEVEL	OCCUPTATIONAL SURVEY REPORT	CONVERTABILITY TO SELF INSTRUCTION	AVERAGE SCORE VALUE
1. Stock Control Levels	4	2	2	0	0	1	-
2. Initial Spares Support Lists	2	2	2	0	1	1	-
3. MILSTRIP Requisitions	6	2	2	0	0	1	-
4. MILSTRIP Related Products	3	0	2	0	0	1	-
5. Base Procurement	6	2	2	0	1	1	-
6. Due-Out Revalidation and Due-In Reconciliation	3	0	2	0	0	1	-
7. Materiel Control	3	2	2	1	0	1	-
8. Monitoring Priority Requirements	5	1	2	0	2	1	-
9. Receipt and Due-Out Releases	4	2	2	0	2	2	2
10. Stock Balance and Consumption Reports	3	0	2	0	0	1	-
11. Base Excesses	3	2	2	0	0	1	-
12. Shipments and Transfers	4	2	2	0	0	1	-
13. Document Control	2	0	2	0	0	1	-
14. Stock Control Functions	7	2	2	0	0	1	-
15. Manual Accounting	1	1	1	0	0	2	-

Col. 3. Score Values: 0 = The individual is not required to have a task knowledge, performance or subject knowledge proficiency.
1 = The individual can: (a) do simple parts of a task; (b) name parts, tools, and simple facts about the task; and (c) identify basic facts and terms about the subject.
2 = The individual can: (a) do most parts of the task; (b) name the steps in doing the task and tell how each is done; and (c) explain relationship of basic parts and state general principles about the subject.

Col. 4. Score Values: 0 = Percent of time performing task is less than 5%
1 = Percent of time performing task is between 5 and 8%
2 = Percent of time performing task is greater than 8%

Col. 5. Score Values: 0 = Individualized instruction is not an effective mode of instruction.
1 = Individualized instruction is as acceptable as current mode of instruction.
2 = Individualized instruction is the most effective mode of instruction.

Figure 4. Part of the Score Sheet for Preliminary Selection of IM Course Segments

Table 1. Candidates for Course Segment Selection (44 Hours)

BLOCK I - GENERAL ANI RESEARCH
Lesson 6. USAF Supply Manual (5 hours) Lesson 7. Master Cross Reference List (3 hours) Lesson 9. Cataloging Handbooks (3 hours) Lesson 10. USAF Federal Supply Catalogs (12 hours)
BLOCK II - ITEM ACCOUNTING AND MAINTENANCE SUPPORT
Lesson 4. Remote Operations (3 hours) Lesson 5. Supply Issue Procedures (6 hours) Lesson 6. Repair Cycle and DIFM Control (8 hours)
BLOCK III - STOCK CONTROL
Lesson 9. Receipts and Due-Out Release (4 hours)

Table 2. Preliminary Selected IM Course Segments (32 Hours)

BLOCK I - GENERAL AND RESEARCH
Lesson 6. USAF Supply Manual (5 hours) Lesson 10. USAF Federal Supply Catalogs (12 hours)
BLOCK II - ITEM ACCOUNTING AND MAINTENANCE SUPPORT
Lesson 4. Remote Operations (3 hours) Lesson 6. Repair Cycle and DIFM Control (8 hours)
BLOCK III - STOCK CONTROL
Lesson 9. Receipts and Due-Out Releases (4 hours)

SELECT FINAL COURSE SEGMENTS

SDC instructional development personnel visited Lowry AFB, where the IM course is given, to discuss final selection of segments with course instructors and with subject matter experts. Selected course segments were audited.

Discussions with instructors and subject matter experts and observations resulted in the substitution of a 3-hour lesson for a 5-hour lesson. The 3-hour lesson had been on the Stage One potential list, but was not selected in Stage Two. Discussions with subject matter experts made it apparent that there was very little difference in skill and knowledge requirements between the two lessons. The substitution of the 3-hour lesson for the 5-hour lesson allowed SDC to select exactly 30 hours of course segments.

Based on the results of the preliminary course selection rationale and on the data collection and analysis effort conducted at Lowry AFB, a final selection of course segments was made. Table 3 lists the selected course segments and the associated instructional hours. All course segments selected are logically tied together, are representative of skills/knowledges and media requirements of the IM course, are suitable for individualized instruction, and can be implemented without dependency on nonselected course segments.

Table 3. Selected IM Course Segments (30 Hours)

BLOCK I - GENERAL AND RESEARCH
Lesson 7. Master Cross Reference List (3 hours) Lesson 10. USAF Federal Supply Catalogs (12 hours)
BLOCK II - ITEM ACCOUNTING AND MAINTENANCE SUPPORT
Lesson 4. Remote Operations (3 hours) Lesson 6. Repair Cycle and DIFM Control (8 hours)
BLOCK III - STOCK CONTROL
Lesson 9. Receipts and Due-Out Release (4 hours)

STEP 3: INVESTIGATE STUDENT POPULATION AND TRAINING ENVIRONMENT CHARACTERISTICS

Instructional materials should be prepared at a level of difficulty appropriate to the reading level, aptitude, and mental ability of the student population. The number of students per class, the physical environment in the classroom, and the adaptability of the classroom to audiovisual equipment to be used on an individualized basis must also be investigated and findings incorporated into instructional materials design. Figure 5 presents Step 3 and its Substeps.

The student population for the Inventory Management Specialist course ranges from "Project 100,000" personnel to college-level personnel. Most students are just out of basic training and have no Air Force job experience. The majority of students attain or exceed the minimum aptitude level score of Administrative 60 or General 60. However, there are a number of students below this minimum. Further consideration is being given to lowering this minimum aptitude level, perhaps to 45. "Project 100,000" personnel are included in the course but are not identified as such. The "Project 100,000" designation only become apparent when failures are being considered for elimination or wash back to later classes.

SUBSTEP 3-1. INVESTIGATE STUDENT APTITUDE AND EDUCATIONAL LEVELS

For the IM Project, records of former students in the existing IM course were examined and course instructors were interviewed to assess the aptitude requirements for the course and the aptitude range and average aptitude level of former students. Reading level and mental ability were assessed through instructor interview. IM course students are somewhat above the Air Force average in administrative aptitude and intelligence. Reading levels are judged to be about those for high school seniors. However, because materials may be used in the

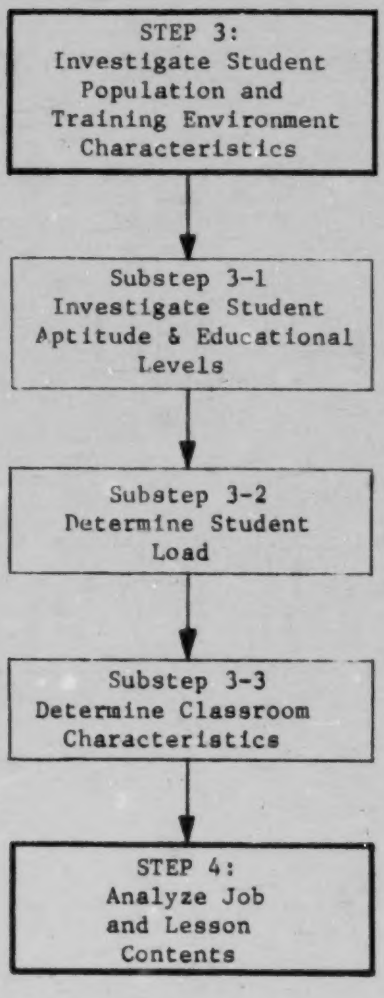


Figure 5. Substeps in Investigating Student Population and Training Environment Characteristics

zero-draft environment, in which there may be a shortage of high aptitude men, the decisions was made to write materials at a basic English level (8th grade) to accommodate all students.

The Air Force administers certain standard aptitude tests to all airmen. These provide some indication of the airman's learning aptitude and reading ability. The AFQT and Gen AQE are measures of general learning aptitude. AFM 35-8 provides an explanation of these tests and their meanings. An analysis of these scores for potential students in a course provides an estimate of the range of abilities of the students and some idea of the relative number of "good" or "less apt" students. It is important to look at this kind of information in planning the instructional materials. If the required information about the students is not available, it may be necessary to provide some testing program or other data gathering means to obtain the information.

PRL-TR-66-1, Estimating Reading Ability Level from the AQE General Aptitude Index, gives a method for estimating the reading level required for a training course if aptitude score levels of current and former trainees can be obtained.

For certain kinds of courses, it may be very important to determine student age range, socioeconomic class, or sex, since for some kinds of material to be learned, student learning styles and past experiences are quite varied. Within the Air Force, age range is small and many classes are all-male. More research will be needed before materials can be developed that effectively account for socioeconomic class differences.

SUBSTEP 3-2. DETERMINE STUDENT LOAD

Instructors in the existing course were interviewed to determine current student load for the IM course. It is important to determine the number of students expected to enter the course and the percentage of those expected to complete it in the normal length of time or within an extended length of time. Instructional strategies, methods, and media are selected with reference to this information.

During the fiscal 1972 period, a new class of 100 students is scheduled to enter the course each week. The aptitude range of students during this period is not expected to change, but the mean aptitude level can be expected to decrease with more students in the lower range of scores.

For these reasons, it is desirable to write the Inventory Management individualized instruction at a basic English level. However, the necessary technical language required on the job will be included.

With a new class each week there will be a class in each of the eight weeks of the present course at any given time. Therefore, tryout of individualized instruction will be possible at any time.

SUBSTEP 3-3. DETERMINE CLASSROOM CHARACTERISTICS

Instructional materials requiring audiovisual equipment must be designed to be compatible with the physical layout and equipment potential of the classroom. Therefore, classroom size, layout, electrical connections, equipment, and equipment budget must be investigated before materials design can begin. SDC found for the IM course that classrooms could accommodate audio tape players and slide projectors to be used on an individualized basis, as long as student load is optimally controlled and scheduled.

The Inventory Management Specialist course is taught in a single air-conditioned structure and utilizes 16 classrooms (eight remedial training classrooms, however, are available in another building). Each classroom is equipped with a felt board, black board, screen, and overhead projector. One of the 16 classrooms is equipped with six operational remote keyboard printers. The maximum student capacity for each classroom is 25; however, the desired optimum size for traditional instruction would be 10-15 students, depending upon the subject matter. Two sets of tape recorders (Sound-o-matic I), slide projectors (Kodak AV900), and 16mm projectors (Graflex) are available on a scheduled basis.

STEP 4: ANALYZE JOB AND LESSON CONTENTS

The purposes of this step are to:

- Select tasks to be trained.
- Identify skills, knowledges, attitudes, and tools/equipment/ materials associated with each task to be trained.
- Establish the sequence of behaviors by which tasks are performed.
- Identify standards and conditions for successful task performance.

(see Figure 6 for presentation of Step 4 and its Substeps.)

SUBSTEP 4-1. RESEARCH JOB AND EXISTING COURSE MATERIALS IN DEPTH

Training is most efficient when it is directed toward preparing students to perform the tasks required of them on the job. For this reason, developers of instructional materials should plan on spending at least ten percent of their time and resources on analysis of the job and of existing lesson materials.

When a course already exists, as it did for IM, and the developer's task consists primarily of individualization of existing material, task analysis can be focused on a precise analysis of existing lessons. New course materials can be derived from the existing course materials, provided that the existing materials are up-to-date and cover job requirements adequately.

The first activity performed in a task analysis is to inventory all tasks performed on the job. A task inventory lists each task in the same format: task/verb first, noun and descriptors second. An example is: Turn vernier knob counterclockwise. The completed task inventory is then used to guide preparation of task analysis information forms and to select tasks for training.

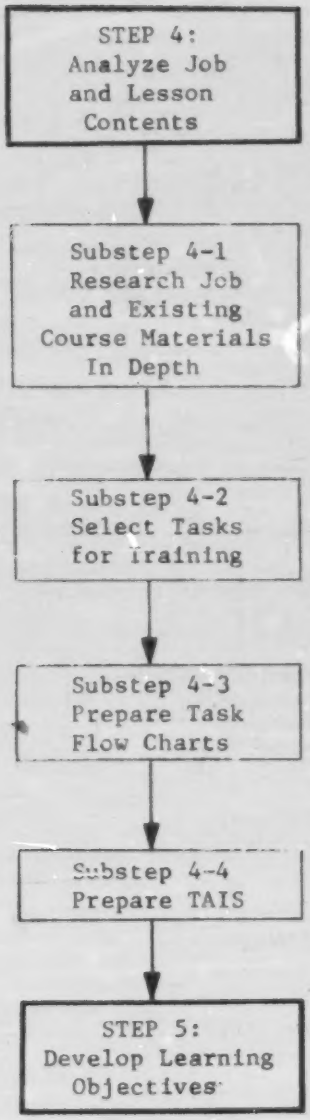


Figure 6. Substeps in Analyzing Job and Lesson Contents

For the IM course, SDC used two paper forms to record task analysis information. These two forms -- a Task Flow Chart and a Training Analysis Information Sheet (TAIS) -- were selected for use because SDC found that the current course materials did cover performance of all the tasks required on the job. When course materials of this kind or detailed task analysis information are not available, an additional form titled, Task and Skill Analysis Sheet (Figure 7 can be used to record job-related information).

SDC examined existing course materials, job descriptions, specialty standards, and occupational surveys to gather all of the information required to prepare an inventory of tasks, Task Flow Charts and TAISs. In addition, SDC observed the current IM course and interviewed instructors.

SUBSTEP 4-2. SELECT TASKS FOR TRAINING

To select tasks for training, SDC prepared an inventory of IM tasks, within selected lesson segments, using the Occupational Survey Report and Specialty Training Standard. The tasks were then examined for similarity of procedure, skills, or knowledges, and for any group of tasks similar in these respects, one was chosen as representative of the group and was therefore selected for training. However, when instructional personnel for the current IM course reviewed these selections, they informed us that the Occupational Survey was outdated and did not include all tasks upon which students would later be tested for promotion. In addition, the amounts of time spent on various tasks, as listed in the Survey were no longer accurate. Therefore the personnel assisted SDC in making a new selection, which is reflected in the Task Flows, discussed in Substep 4-3.

TASK AND SKILL ANALYSIS SHEET

TASK NAME: _____ (verb) _____ (object)

TASK ID NO. _____

TASK TYPE: _____

TASK LOCATION: _____

EQUIPMENT/FORMS ID: _____

PERFORMANCE TIME: _____ FREQUENCY: _____

NO. PERSONS: _____ COORDINATION: _____

TASK CRITICALITY: _____

TASK LOCATION: _____

STARTING CUE: _____

ENDING CUE: _____

TOOLS: _____

TEST EQUIPMENT: _____

MATERIALS: _____

ENVIRONMENT: _____

BEHAVIORS: _____

HAZARDS: _____

SUPERVISION: _____

PROCEDURES DOCUMENTS: _____

OTHER: _____

PERFORMANCE STANDARD: _____

TASK STEPS:

1.
2.
3.
4.
5.

Figure 7. Task and Skill Analysis Form, used to Record Job-Related Information

SUBSTEP 4-3. PREPARE TASK FLOW CHARTS

Task Flow Charts represent the tasks to be trained, their task elements, and the relationship among them. A Task Flow Chart was prepared for each lesson for which individualized materials were to be prepared. Decisions were made during this Substep as to the sequencing of tasks within a lesson and any changes to be made to organization and sequencing of lessons in the existing course.

Figure 8 shows a Task Flow Chart for the IM course. The numbered items in this chart correspond to the explanatory paragraphs below.

TASK FLOW EXPLANATION

(1) Lesson Topic Name. SDC in an earlier step determined this topic was suitable for conversion to individualized instruction.

(2) Block and Lesson IDs. These identification numbers refer to the planned sequence of instructional materials.

(3) Task Statements. Each of the numbered statements refers to a task performed on the job that is covered within this lesson topic.

(4) Major Task Flow. Each of these boxes corresponds to one of the numbered task statements. Their sequence indicates the order in which the tasks are performed and are to be taught.

(5) Task Elements Flow. Each of these boxes represents a subtask of a major task. Their sequence indicates the order in which the task elements are performed and are to be taught.

(1) FEDERAL SUPPLY CATALOG

(2) Block No. I Lesson Module B

(3) TASKS

4. Obtain Index Numbers from FSN
5. Identify and Interpret the Information Contained in AF-IL Parts 1 & 2 Data Groupings
6. Obtain Minimum Data Necessary to Acquire and Account for an Item of Supply Contained in AF-M'
7. Maintain the Federal Supply Catalogs

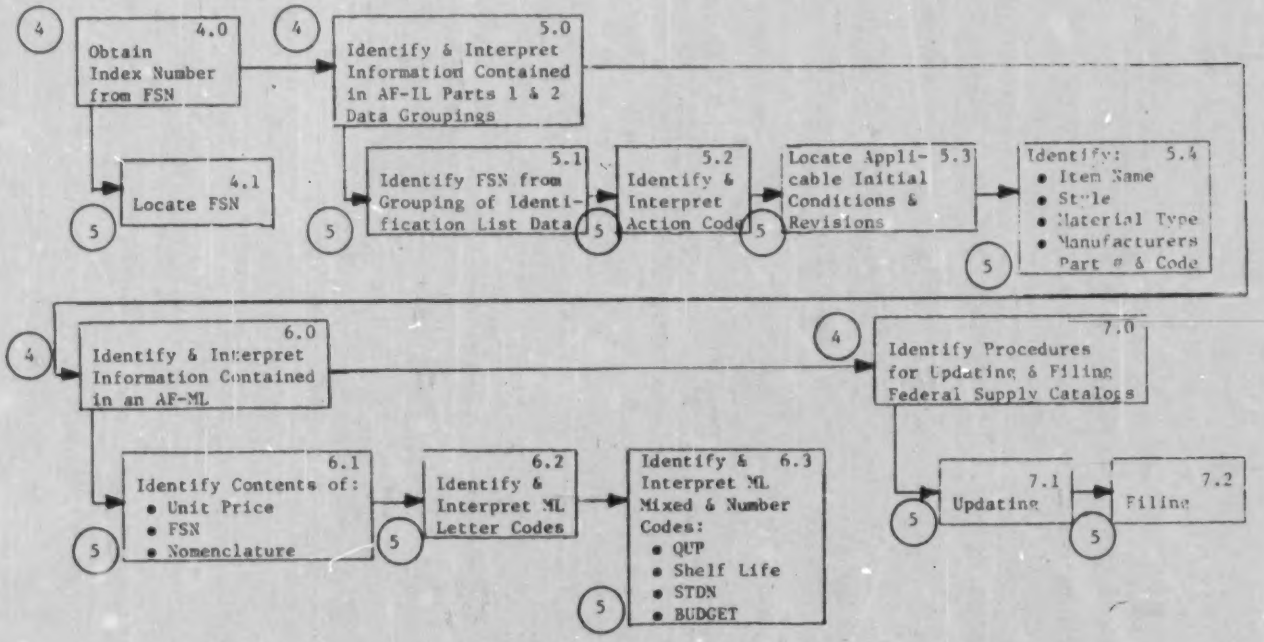


Figure 8. Task Flow Chart for an IM Lesson

If there is no existing course for which new instructional materials are being prepared, SDC recommends that instructional developers prepare Task Flow Charts for the job and also for the course material. The first set should relate directly to the tasks performed on the job. After Task and Skill Analysis sheets have been prepared, tasks required to be trained have been determined, and teaching sequence of major blocks has been determined, a second set of Task Flow Charts oriented toward course presentation sequencing can be prepared, using the first as a reference for sequencing task performance.

SUBSTEP 4-4. PREPARE TAIS

A Training Analysis Information Sheet (TAIS) is shown in Figure 9. The circled numbers correspond to the explanatory paragraphs below.

TRAINING ANALYSIS INFORMATION SHEET (TAIS) EXPLANATION

(1) TAIS IDs. Lesson module and block number are the same as for the associated Task Flow. A TAIS is prepared for each task shown on a Task Flow; therefore, Task Code number on the TAIS refers to the associated task number on the Task Flow.

(2) Task. The task statement from the Task Flow is shown here.

(3) Conditions. Conditions are, in the case of the IM course, derived from existing course and IM Specialty standards. They state what must be learned and in what context performance must be demonstrated.

(4) Standard. This is that performance standard that is considered adequate to ensure that the task is learned under the stated conditions.

(5) Task Elements. Each of these statements corresponds to one of the task elements shown on the Task Flow Chart. Each is a subtask to the task for which the TAIS is written.

BLOCK NUMBER I

LESSON MODULE B (1)

TASK CODE 04

(1) LESSON NUMBER 10

TRAINING ANALYSIS INFORMATION SHEET

(2) 1. TASK: Obtain Index Numbers from FSNs

(3) 2. CONDITIONS: Given four (4) Federal Stock Numbers, obtain the assigned index numbers using the Federal Supply Catalog Identification List (C-1610-IL-AF)

(4) 3. STANDARD: No errors

4. TASK ANALYSIS:

TASK ELEMENTS	PREREQUISITE KNOWLEDGE OR SKILL REQUIREMENTS	TRAINING MATERIALS	REFERENCES
(5)	(6)	(7)	(8)
1. Locate FSN.	1a. Know numerical sequence. 1b. Reads off assigned number.	C-1610-IL-AF	C-1-AF, C-1610-IL-AF, C-1610-ML-AF, SG/WB-I-10 HOI-10 HOI-10-1, HOI-10-2, C-RL-1-AF, Transparencies #120, 121, 122, 123

Figure 9. A TAIS for An IM Task

(6) Prerequisite Knowledge or Skill Requirements. These requirements are listed for each task element. Each must be taught or known before training on the actual task begins.

(7) Training Materials. These are materials (other than SDC-produced materials) that are required to perform the task.

(8) References. These are references to materials prepared for the existing training course and for the job. They were used by SDC in developing the individualized materials.

Training Analysis Information Sheets provide basic information for developing Learning Objectives and for developing the instructional materials themselves.

STEP 5: DEVELOP LEARNING OBJECTIVES

Learning objectives are the base from which course materials are produced. Learning objectives specify the kind of performance to be tested, also. Two kinds of learning objectives are developed: (1) criterion objectives, and (2) enabling objectives. Criterion objectives are end objectives associated with a specific task. Each specifies student behavior required on the job. Enabling objectives are subobjectives to criterion objectives; each enabling objective represents a skill or knowledge necessary to successful performance of a given task. (Figure 10 presents Step 5 and its Substeps.)

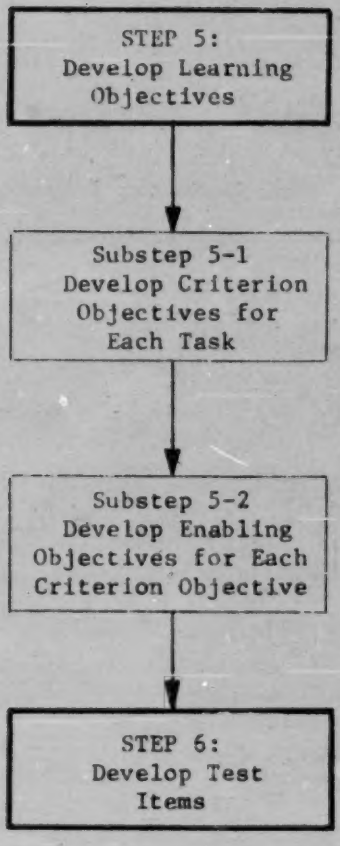


Figure 10. Substeps in Developing Learning Objectives

Figure 11 shows a sample Learning Objectives Worksheet for a specific IM Task. The circled numbers match those in the explanation below.

LEARNING OBJECTIVES WORKSHEET EXPLANATION

(1) Learning Objective IDs. These identity numbers are carried over from the IDs for the task. Each TAIS has a matching Learning Objectives Worksheet.

(2) Criterion Objectives. One or more criterion objectives for the task are listed here.

(3) Enabling Objectives. Enabling objectives for the task are listed here.

BLOCK NUMBER I

LESSON MODULE B (1)

(1) TASK CODE 04

LESSON NUMBER 10

LEARNING OBJECTIVES

CRITERION OBJECTIVES	ENABLING OBJECTIVES
(2) 1. Given various FSNs, look up the index number in the FSN to Index Cross Reference portion using C-1610-IL-AF.	(3) 1. State FEDERAL STOCK NUMBER when questioned concerning what information must be known for direct use of a USAF Federal Supply Catalog. (3) 2. State INDEX NUMBERS as being what the FSN is cross referenced to. (3) 3. When asked how the two types of index numbers are identified within the Item Identification List, fill in NUMBER and PART 1 for complete item ID and fill in LETTER and PART 2 for minimum description.

Figure 11. A Learning Objectives Worksheet for the IM Course

SUBSTEP 5-1. DEVELOP CRITERION OBJECTIVES FOR EACH TASK

What qualities do good criterion objectives have? The following qualities were considered essential to development of the IM instructional materials:

- Each objective requires the student to demonstrate a skill or knowledge that is directly related to task performance. Such skills and knowledges can be derived from the TAISs previously prepared. The conditions section of the TAIS provides the information required.
- Since test items will be derived for each learning objective, observable behaviors that can be tested must be specified as learning objectives.

Criterion objectives, if there is more than one for a task, should be listed in the order in which skills and knowledges are required in task performance.

SUBSTEP 5-2. DEVELOP ENABLING OBJECTIVES FOR EACH CRITERION OBJECTIVE

Good enabling objectives specify in a step-by-step fashion the elements of behavior involved in reaching criterion objectives. Enabling objectives should possess the same qualities as do criterion objectives, but on a more detailed level.

STEP 6: DEVELOP TEST ITEMS

Test items are keyed directly to criterion learning objectives. A test item for an objective is phrased to show how it can be known whether a student has or has not met the learning objective. Criterion test items are written for each criterion objective. Enabling test items (subtest items to a criterion test item) are developed to test for mastery of each element of a given task. (Figure 12 presents Step 6 and its Substeps.)

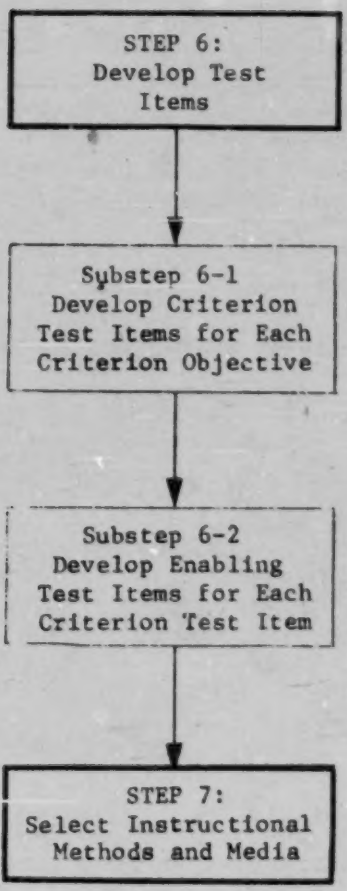


Figure 12. Substeps in Developing Test Items

Figure 13 shows an example of a Test Item Worksheet. The numbers in circles match the numbers in the discussion below.

TEST ITEMS EXPLANATION

(1) Test Item Worksheet IDs. These IDs match those on the TAIS and on the Learning Objective Worksheet.

(2) Criterion Tests. At least one item is written for each learning objective. The statement labeled CONDITIONS on the TAIS is used to derive the content and context of the test item.

(3) Enabling Tests. These items test the individual elements of skill or knowledge that are required for successful performance on each criterion objective.

SUBSTEP 6-1. DEVELOP CRITERION TEST ITEMS FOR EACH CRITERION OBJECTIVE

The following qualities should be built into criterion test items:

- Good criterion test items require students to demonstrate skills and knowledges directly related to the criterion objectives.
- Good test items elicit observable and measurable behaviors. One should keep scoring procedures in mind when developing test items.
- For paper and pencil tests, questions with fill-in answers are often preferable to multiple-choice questions because the behavior required to answer is usually more closely related to actual task performance on the job. However, if multiple-choice questions are used, they should preferably have four or five alternative answers.
- Performance-oriented (as opposed to paper and pencil) items should include a statement of the context in which an observation is to be made of student performance, the exact behavior(s) to be observed, correct performance, and potential incorrect alternatives.

BLOCK NUMBER I

LESSON MODULE B (1)

(1) TASK CODE 04

LESSON NUMBER 10

TESTS

CRITERION TESTS	ENABLING TESTS
(2) 1. What are the Index Numbers for the following FSNs? a. 1610-546-3319 -- (B001-0272) b. 1610-081-7184 -- (0096-8000) c. 1610-301-1557 -- (B000-9686) d. 1610-996-0036-BD -- (B000-2234)	(3) 1. What information must be known for the direct use of a USAF Federal Supply Catalog? (Federal Stock Number) (3) 2. The FSN is cross referenced to: (Index Numbers). There are two kinds of the above numbers within the Item Identification List. The complete Item ID is one and the minimum description is the other. (3) 3. The first character of the minimum description is a (letter). The minimum description is known as a Part (2) list. (3) 4. The complete item ID is known as a Part (1) list and its first character is a (number).

Figure 13. A Test Item Worksheet for the IM Course

SUBSTEP 6-2. DEVELOP ENABLING TEST ITEMS FOR EACH CRITERION TEST ITEM

To write enabling test items, developers must analyze the criterion item in depth to determine each separate skill and knowledge involved in performance. The TAIS and the list of enabling learning objectives provide the information used to derive these elements. Enabling items must be constructed just as carefully as are criterion items, to elicit observable, measurable behavior.

STEP 7: SELECT INSTRUCTIONAL METHODS AND MEDIA

Four major factors determine instructional methods and media to be used for individualized instruction: 1) characteristics of the tasks to be trained, 2) training concept and instructional strategy, 3) characteristics of the students, and 4) physical realities, such as classroom space, equipment budget, etc. In Step 7, a worksheet is made, showing each task's and each task element's major characteristics insofar as methods and media selections are concerned. The worksheet is then used with types of learning list and a selection matrix to identify the optimal method-media combination for each learning element listed on the TAIS discussed in Step 4. The worksheet, types of learning list, selection matrix, and the selection procedure, are based upon the work of personnel at the U.S. Army Signal School, Fort Gordon, Georgia. References to this work are provided in Appendix B to this document.

Signal school personnel feel, based on review of methods and media selection literature and upon their own practical experience in developing instructional materials, that prime methods and media selection factors are: a) student characteristics, b) general instructional strategy characteristics, and c) type of learning involved for each task and task element to be learned. Their selection matrix encompasses all of these factors.

(Figure 14 presents Step 7 and its Substeps.)

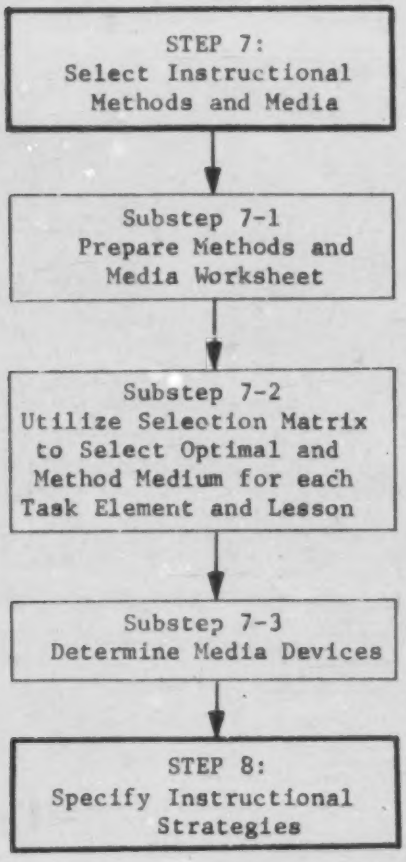


Figure 14. Substeps In Selecting Instructional Media

SUBSTEP 7-1. PREPARE METHODS AND MEDIA WORKSHEET

This substep has several parts. First, developers must decide upon the nature of the tasks elements, the nature of the student population, and the instructional strategy based upon the general training concept. These decisions are entered on the Methods and Media Worksheet. (Figure 15)

METHODS AND MEDIA WORKSHEET

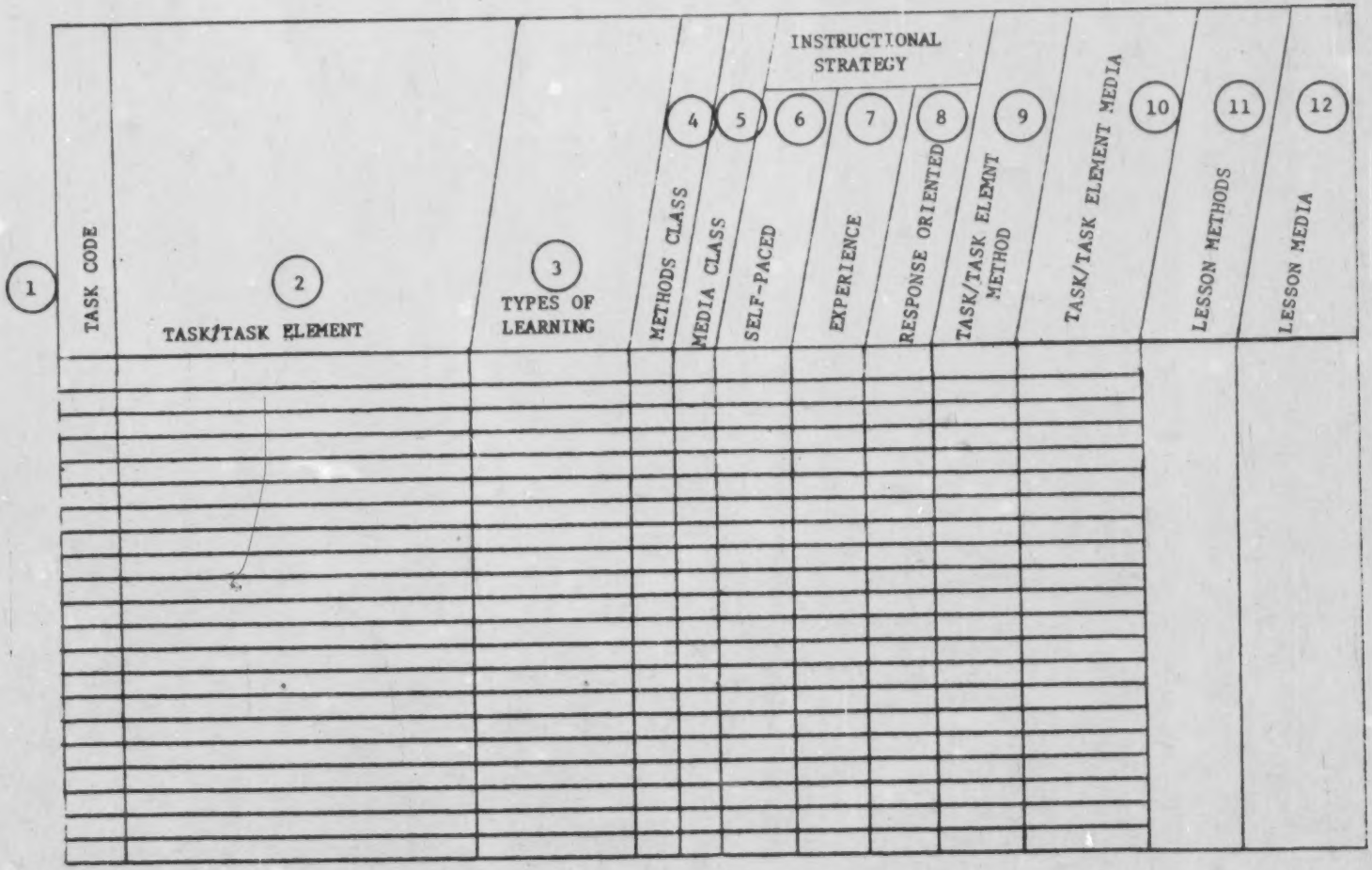


Figure 15. Methods and Media Worksheet

The numbers in circles in Figure 15 match the numbers in the discussion below.

METHODS-MEDIA WORKSHEET EXPLANATION

(1) Task Codes. The task code number and the task element number are listed as the identification code, one to a line.

(2) Task and Task Elements. Statements are listed as they appear on the TAIS.

(3) Types of Learning. The Types of Learning List, Figure 16, is used to select a one-word description of learning type for each task as a whole and for each task element. The explanations on this list are used to make the determinations. Examination of the learning objectives and test items for a task aids in making the determinations. When type of learning has been selected, it is entered on the Methods and Media Worksheet, Column 3.

(4) Methods Class Code. On the right of the Types of Learning List, Figure 16, are two columns, one for Methods, and one for Media. When Learning Type for a task or task element has been determined, the Methods Class Code shown is transcribed onto the Methods and Media Worksheet,,Column 4.

(5) Media Class Code. The Media Class Code shown on the Types of Learning List is also transcribed onto the Methods and Media Worksheet, Column 5.

(6) Self-Paced. This is the first of the instructional strategy decisions to be made to aid in selecting methods and media. To fill in this column for a particular task or task element, the following list of questions is answered:

- Does the learning include value judgements?
- Does the subject material or equipment change frequently?
- Must the student complete the learning within a structured time frame?
- Will a self-paced program be more costly than a group-paced program?
- Does the task element require a team effort?

TYPES OF LEARNING LIST

LEARNING TYPES. Select the most appropriate learning type for each task element first. Then select the type that best characterizes the entire task.	METHODS CLASS CODE	MEDIA CLASS CODE
1. Factual Information. Learning names, events, terms, definitions.	I	A
2. Decision. Selecting a course of action from several choices.	IV	A
3. Diagnosis. Using cues to identify solutions to problems or to define a problem.	I	B
4. Procedure. Carrying out a sequence of acts or operations in the correct order.	I	B
5. Principle. Knowing theory, concepts, rules; understanding why, how, or when events occur.	I	B
6. Organization. Knowing how parts are organized functionally.	I	B
7. Construction. Knowing how objects are structured.	I	C
8. Identification. Knowing names and locations.	I	C
9. Operation. Knowing how something functions.	II	D
10. Inspection. Checking against standards.	III	E
11. Manipulation. Manually working with objects.	V	F
12. Evaluation. Making value judgments.	VI	F

Figure 16. Types of Learning List

If the answer to any of these questions is Yes, group instruction is more appropriate and an "0" is entered in the Self-Paced columns. If the answer to all the questions is No, then a "1" is entered in the Self-Paced column for the task or task element.

(7) Experience. Does the trainee have previous training or prior experience which is applicable to a given task or learning element? If so, a "1" is entered in the Experience column; if not, an "0" is entered. This determination is made by first considering whether the students have had training or experience before entering the class. Then for a given task or task element/learning type combination, consideration is given to whether there has been a previous related task or task element, possibly of a different learning type.

(8) Response-oriented. If the trainee must respond to the task or learning element by doing something, the answer is yes, and a "1" is entered for this column. If the trainee must only read, see, or hear the content, then the answer is No and a "0" is entered.

(9) Learning Element Method. To fill in this column, the Methods and Media Selection Matrix is used. Figure 17 shows this matrix. The matrix has its own numbered set of explanations. Read number (1) and (2) for a description of how Learning Element Method entry is obtained.

(10) Learning Element Media. See Figure 17 and read its explanation number (3) for a description of how the Learning Element Media entry is obtained.

(11) Lesson Method. Once all of the task and learning element methods are selected using the selection matrix, a general or combination method for the entire lesson can be entered by inspecting the method entries for all tasks and elements of the lesson and determining all of the methods required for the lesson.

(12) Lesson Media. Once all of the task and learning element media are selected using the selection matrix, all the media required for the lesson can be listed in the lesson media column. If more than three media are required to be used within a 1-hour lesson time block, the developer should consider reorganizing the task structure to avoid this, or should consider making all learning elements within a lesson more compatible with respect to the Response-Oriented entry. Generally, many changes of media within a short time period disrupt learning and increase training time.

SUBSTEP 7-2. UTILIZE SELECTION MATRIX TO SELECT OPTIMAL METHOD AND MEDIUM FOR EACH TASK ELEMENT AND LESSON

The Selection Matrix is shown in Figure 17 . It is used to make methods and media selections to enter on the Methods and Media Worksheet. The numbers in circles on the matrix match the circled numbers in the explanation below.

SELECTION MATRIX EXPLANATION

(1) Instructional Strategy. For a given task or learning element, the pattern of zeros and ones on the Methods and Media Worksheet match as a pattern on the Selection Matrix. The method and media appropriate for the task or task element are selected from the matrix row with the matching pattern.

(2) Method Class Code. For the same task or task element considered in (1) above, the method class code on the Methods and Media Worksheet matches a method class code on the Selection Matrix. The matrix box that is the intersection of the instructional strategy pattern (row) and Methods Class (column) contains an abbreviation that stands for the selected method. Explanations of the abbreviations are at the top of the matrix. The method is entered on the Methods and Media Worksheet.

(3) Media Class Code. Media selection is performed in the same way as methods selection. The selected media are enetered on the Methods and Media Worksheet. The media listed in the matrix were derived through rational analysis and through analysis of research findings relating media use to learning effectiveness. New research may require changes in the matrix at a later date, and perhaps other instructional strategy factors or types of learning will be added for consideration in the selection process.

(4) Abbreviation Explanations. These phrases explain the abbreviations contained in the body of the matrix.

SELECTION MATRIX

CPE = Controlled Practical Exercise
CS = Case Study
D = Demonstration
IE = In-basket Exercise
IP = Incident Process
IPE = Independent Practical Exercise
PI = Programmed Instruction
SA = Study Assignment
TP = Team Practice
PE = Practical Exercise
( ) = Either or Both
P = Print
AO = Actual Object
SV = Still Visual
MV = Motion Visual
W = With

(4)

(1) Inst. Strat.* 0=No 1=Yes			METHODS CLASS CODE (2)						MEDIA CLASS CODE (3)					
Self-Paced	Experience	Response	I	II	III	IV	V	VI	A	B	C	D	E	F
0	0	0	SA	D	D	SA	D	D	P	PW/AO&SV	PW/SV	PW/MV	PW/AO&SV	PW/MV
0	0	1	CPE (PI)	CPE (PI)	CPE	CPE (PI)	CPE	PI	P	PW/AO&SV	PW/SV	PW/MV	PW/AO&SV	PW/AO&MV
0	1	0	SA	SA	SA	SA	SA	SA	P	PW/SV	P	PW/SV	PW/SV	PW/SV
0	1	1	PE (PI)	PE (PI)	PE TP	CS	TP	CS	P	PW/SV	P	PW/SV	PW/AO	PW/SV
1	0	0	SA	P	SA	SA	D	D	P	PW/AO&SV	PW/SV	PW/MV	PW/AO&SV	PW/MV
1	0	1	IPE (PI)	IPE (PI)	PI (PE)	IPE (PI)	PI (PE)	PI (IE)	P	PW/AO&SV	PW/SV	PW/MV	PW/AO&SV	PW/AO&MV
1	1	0	SA	SA	SA	SA	SA	SA	P	PW/SV	P	PW/SV	PW/SV	PW/SV
1	1	1	IPE (PI)	IPE (PI)	IPE	IP IE	IPE	PI	P	PW/SV	P	PW/SV	PW/AO	PW/AO

* This matrix is used for individualized courses in which students can read at the Basic English level or higher.

Figure 17. Selection Matrix

Figure 18 shows a portion of the Methods and Media Worksheet that has been prepared for the IM course.

Notice that the Lesson Media column includes the use of a tape recorder in one instance, although the Selection Matrix does not recommend the audio medium for students who can read and comprehend faster than they can listen and comprehend. SDC added the use of the audio medium to lessons in which one of the learning types was Manipulation so that students could perform the manipulation without having to look away to print. For manipulation tasks, students probably cannot read faster than they can listen. Another portion of the Selection Matrix, not included in this report, contains methods and media selections for this circumstance, and an audio medium is specified.

METHODS AND MEDIA WORKSHEET

TASK CODE	TASK/TASK ELEMENT	TYPES OF LEARNING	METHODS CLASS	MEDIA CLASS	INSTRUCTIONAL STRATEGY: SELF-PACED	INSTRUCTIONAL STRATEGY: EXPERIENCE	INSTRUCTIONAL STRATEGY: RESPONSE ORIENTED	TASK/TASK ELEMENT METHOD	TASK/TASK ELEMENT MEDIA	LESSON METHODS	LESSON MEDIA
4.0	Obtain index no. from an FSN	Procedure	I	B	1	0	1	PI	PW/AO&SV	PI	AO, slide projector
4.1	Locate FSN	Fact	I	A	1	0	1	PI	P		
8.0	Load DD Forms 1348-1	Manipulation	V	F	1	0	1	PI(PE)	PW/AO&MV	PI(PE)	AO,tape recorder, slide projector

Figure 18. Part of a Completed IM Course Methods and Media Worksheet

After filling out the selection matrix, some consideration of practical constraints is important. These constraints may include limitations in facilities, equipment or personnel. This can be either in the actual classroom or in the support areas. Such considerations may limit the course developer's options but they also enable an early avoidance of impractical decisions. If a constraint imposes minor limitations which do not degrade instruction there are no real problems. If a constraint threatens to degrade the instructional system, then a problem has been identified which should be posed to those who have the authority to effect the solution.

The selection of media devices involves many factors beyond the scope of this report and although use of a particular device seldom imposes real limitations on the ability of learning materials to teach, its selection does require that the materials are physically compatible with it. This requires careful attention to the many details that affect the match of film, tape, etc. to the device and to classroom or maintenance environments. This coordination should be started even before the final selection of device or media to preclude subsequent problems that interfere with student learning and create real time delays or expensive correctional procedures.

SUBSTEP 7-3. DETERMINE MEDIA DEVICES

A specific medium, as defined on the Selection Matrix, does not require a specific device for display of training material. For example, print could be in a book, on loose sheets of paper, or on microfiche.

For the IM course, practical realities narrow down the possible choices of devices for presentation of materials, but the basic media are available (--, written word, still pictures, instructor lecture, audio, or actual objects. Motion visuals present a more difficult problem, as would commercial or specially-designed teaching machines if they were required. At a later time, the IM course will very likely be computer-assisted. Materials produced now on paper, or possibly even on slides, may then be displayed at a computer terminal. But at this time, that mode of presentation is not available.

For individualized instruction, film and instructor lectures are not as satisfactory as slide sets and audio tape, because it is expensive to individually pace films and lectures. They are much more cost-effective when viewed and listened to by a group. Individual film devices are quite expensive. For the IM course, for any motion visuals required, the use of audio-pulsed slides will be explored. The tasks for which motion visuals were specified are quite simple and therefore the slides can replace motion visuals without a loss in learning efficiency.

For some applications, the number of audiovisual devices required may make the cost of audiovisual devices prohibitive. The number needed depends on the proportion of the course that is to be taught using the devices. If an individualized course utilizes only audiovisual methods, then of course one device will be required for each student. For the eight-week IM course, which 20 students enter each week, it was determined that 25 devices should be sufficient. However, the proportion of time that students spend with the devices is small relative to total estimated individualized course time. A student in the IM course will spent only about 5-10% of the time using an audiovisual device, but at the beginning of the last 60 hours, which are self-paced, about 20 students will be wanting these devices at the same time. It was decided that acquisition of 25 devices would allow the placement of at least one device for each two students in the room in which the first two modules of the self-paced portion of the course would be taught, ensuring that delay time would be relatively short. A smaller number of devices could then be placed in each of the rooms used for later modules utilizing audiovisual devices, since self-pacing will spread student progress. It is hoped that research studies in this area will soon provide course developers with a decision-making tool to estimate the number of devices required for given numbers of students and given proportions of course time in which the devices will be utilized.

To determine practical media devices for a course, developers must investigate money available, cost of devices, and compatibility with the physical characteristics of the classroom, and student load. These investigations should take place very early in the materials development process in order to ensure compatibility of materials and devices.

STEP 8: SPECIFY INSTRUCTIONAL STRATEGIES

To determine instructional strategies to be used in developing the IM course, SDC designed a worksheet to be filled-in as development work progressed. Then, during Step 8, this worksheet was completed. The completed worksheet specifies the instructional strategy bases with which all materials must be compatible. A program of instruction reference sheet for the course was also prepared for Step 8. (Figure 19 presents Step 8 and its Substeps.)

SUBSTEP 8-1. PREPARE STRATEGY WORKSHEET

Figure 20 shows the Instructional Strategy Worksheet, filled-in for the IM course. The top item on the sheet specifies the given instructional strategy conditions under which the IM course is to be developed. The Air Force expects SDC to fulfill these conditions. The next group of items specifies SDC's general training concept under these conditions. The final item specifies an organizational strategy to optimize learning effectiveness.

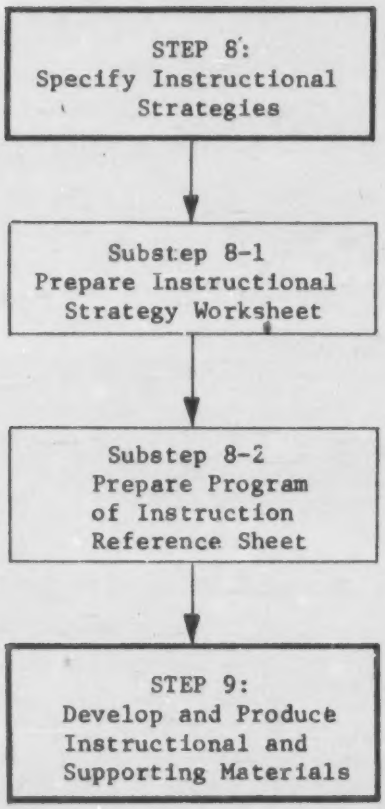


Figure 19. Substeps in Specifying Instructional Strategies

On the worksheet in Figure 20, each of the numbers in circles matches a number in the Instructional Strategy Worksheet explanation given below.

INSTRUCTIONAL STRATEGY
WORKSHEET EXPLANATION

(1) Contract Conditions. Three entries were made for this item. SDC was requested to provide individualized materials and to select course segments for which individualization was possible. Computer adaptability was also requested in the contract. This condition affects the form in which student responses can be required. Course materials requiring an "out-loud" response, a manipulation of an object, or a long written passage should be curtailed as much as is feasible if a course is to be presented later by computer peripheral equipment, since computer peripheral equipment is not cost-effective in evaluating these kinds of responses. SDC is not producing the entire IM course. Therefore, the organization and content of SDC-produced materials must not disturb the unity of the course as a whole. ATC Reg 52-3 describes policies for development of learning objectives, progress checks, and measurement tests.

Individualization for the IM course is defined as self-pacing. Other aspects of individualization that were considered and rejected are production of different materials for different student learning styles, such as all audio materials for those who read the poorest, and all print materials for high achievers in school, and the use of different language levels for identical content, with the student selecting the level he feels most comfortable with or with a pretest determining the most appropriate language level for a particular student.

(2) Task/Knowledge Orientation. This item refers to the educational goals for the IM course. A job training course, such as the IM course, should require the trainee to demonstrate his ability to perform tasks associated with the job, not merely his knowledge about the job.

INSTRUCTIONAL STRATEGY WORKSHEET

Contract Conditions. List those affecting instructional strategy:

(1) Individualization of materials, self-pacing.

Computer Adapatability.

Course segments must dovetail with segments not being produced by SDC.

Measurement and progress check strategies must conform to ATC Reg 52-3, Measurement of Student Progress and Achievement.

General Training Concept for Course:

(2) Task/Knowledge Orientation. Check concept appropriate for course.

____ not task oriented. Knowledge only.

____ some segments require task orientation or problem solving.

__X__ course trains for a job; most segments task oriented.

____ other, explain.

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 1 of 6)

3 Testing. The IM course trains students to perform tasks, but these tasks are primarily paper and pencil tasks, rather than equipment or people-related tasks. Therefore, realistic testing requires paper and pencil tests oriented to task performance.

4 Materials Sequencing. There are many ways course materials can be organized. When the goal of a course is to elicit successful task performance the best way to sequence material is by the order in which work is performed - by task flow. This can be done within each task for the IM course, and among tasks in some cases. But some IM tasks are not performed in a specific order. These tasks are to be sequenced as they were in the original IM course, to enhance the compatibility of the new and old materials.

5 Role of Instructor. Since the IM course is to be self-paced, the instructor will not be the prime means of presenting material. He will, therefore, have more time for performing the other instructor roles listed.

6 Advance and Review Organizers. The use of organizers is recommended for the IM course. An advance organizer is presented prior to lesson content and provides education materials relevant to the learning objectives of the lesson module, but not essential to their achievement. Each advance organizer introduces the student to the subject matter to be presented and identifies the skills and knowledges to be learned. For material with more than a minimal degree of cognitive content as (opposed to psychomotor content) studies show that advance organizers enhance learning by aiding cognitive organization. A review organizer is a restatement of the advance organizer and is presented after the lesson content and just before the criterion test. The student re-reads the organizer to assist in determining whether he can meet the learning objectives of the lesson.

(3) Testing. Check concepts most appropriate for course:

- X "hands-on" testing on objects.
- ____ all paper and pencil testing, oriented to knowledge.
- X paper and pencil testing, oriented to task performance.
- ____ other, explain.

(4) Material Sequencing. Check concepts appropriate for most units.

- ____ simplest to most difficult, no other organizer.
- X by units of content, topics.
- X by task flow.
- ____ other, explain.

(5) Role of Instructor. Check usual roles.

- ____ prime means of presenting material.
- X diagnose student skills and knowledges.
- X monitor student progress.
- X assist students upon request.
- ____ other, explain.

(6) Advance and Review Organizers. Check appropriate statement.

- X recommended.
- ____ not recommended.

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 2 of 6)

(7) Presentation of Stimulus. This entry specifies the cue and prompt strategy to be employed with most material. Descreasing cues and prompts are very effective in producing learning. At the end of a cue and prompt sequence, the learner needs no prompts in the stimulus presentation in order to make a correct response. When material is not too difficult to learn and remember, limited prompts will be satisfactory.

(8) Student Response. This entry specifies the forms in which responses will be elicited from trainees. Selective responses are true-false, multiple-choice, matching, etc. Constructed response items more closely approximate IM tasks than do selective response items. Multiple-choice answers do enable material developers to branch students more easily and will be used for remedial branching as well as for knowledge-oriented items. The methods used to elicit student response in the IM course will be varied also to provide student interest. Many responses of the same kind can become boring to the student. Free responses are not computer adaptable in that the correctness must be evaluated by an instructor, who must also provide feedback.

(9) Feedback. Research has shown that immediate feedback to the student about the correctness or incorrectness of his response is most effective in producing learning. There are circumstances and course content where this is not possible but immediate feedback is most appropriate for the IM course.

(7) Presentation of Stimulus. Check appropriate method.

____ straight text, no prompts.
__X__ decreasing cues and prompts to response.
__X__ limited prompts.
____ other, explain.

(8) Response. Check appropriate types.

__X__ selective response.
__X__ constructed response.
____ free response.
____ other, explain.

(9) Feedback. Check appropriate concepts.

__X__ immediate feedback for each response.
____ feedback at ends of units; units are _____.
____ other, explain.

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 3 of 6)

(10) Student Progression. A cost-effective method of guiding a student through self-paced material is usually linear. That is, a student progresses from one lesson element to the next in the sequence. Each student responds to each item. SDC plans a modified main-line track in which the majority of students will achieve a correct response for each main-line track stimulus presentation. However, if correct response is not obtained, then branching to supplementary material will be performed. The combination of these two methods is often called linear eclectic. Some of the supplementary material will not be prepared until after the validation phase of the IM Project. At that time, developers of the materials will have more information about the learning problems a student is likely to have as he progresses through the material. Supplementary materials can then be constructed to solve these problems.

(11) Review. Use of a review element at the end of each lesson is a cost-effective method for the student to enter himself in a loop to previously studied material to ensure that he achieves lesson learning objectives.

Choice of the "no review" category would cause a great deal of supplementary material to be developed, based on diagnosis and evaluation, for each lesson. To avoid this, the materials will aid a student to self-prescribe review based on his responses to the criterion items of a lesson. A review organizer and student review matrix will be incorporated in the materials for each lesson for this purpose. A review matrix provides the student with references to materials to be reviewed for each learning objective.

(10) Student Progression. Check usual means.

__X__ linear.

__X__ branching, small step.

____ branching, scrambled book.

____ other, explain.

(11) Review. Check appropriate concepts.

____ no review.

__X__ review element at ends of lessons.

____ other, explain.

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 4 of 6)

(12) Evaluation. Evaluation is here defined as referring to any measurement and diagnosis other than feedback to responses on individual items. SDC decided not to use any pretest prior to the course or to any given lesson. Students generally have no background experience with the subject matter that could be tapped with a pretest. Measurement of student performance will occur at the end of the course, for a course grade and also at the end of each lesson, in the form of a criterion test. The diagnostic type of evaluation will be used within a lesson to assess student performance on enabling objectives and also after each criterion test to aid the student in deciding whether he should progress to the next lesson or wash-back to the prior lesson.

(13) Language Level. Appropriate language level for the IM course is Adult Basic because of the varied student abilities in the course. Adult Basic in about 8th grade reading level, with the addition of required terminology for the tasks to be trained.

(14) Cognitive Level. (Adapted from Taxonomy of Educational Objectives, Benjamin S. Bloom, Ed. See references in Appendix of this document.) The IM course does not require students to demonstrate the higher intellectual abilities (analysis, synthesis and evaluation) because the job is highly proceduralized and forms are used to organize work. Therefore, the IM course need only require students to apply what they have learned in the course to job performance.

(12) Evaluation. Check appropriate types and circle locations.

__X__ diagnostic type, location A B (C) (D) E

__X__ measurement type, location A B C (D) (E)

____ other type, explain and list location letters.

Loc A = prior to beginning course
Loc B = prior to lesson elements
Loc C = within lesson
Loc D = subsequent to lesson
Loc E = subsequent to all lessons

(13) Language Level. Check appropriate level.

__X__ basic for adults.

____ college level.

____ other, explain.

(14) Cognitive Level. Check highest level of most material.

____ knowledge

____ comprehension

__X__ application

____ analysis

____ syntheses

____ evaluation

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 5 of 6)

(15) Course Presentation Location. Instructional methods and media to be used, plus student load and classroom characteristics, determine where lesson materials can be used by students. For the IM course, no special facilities, such as movie theaters, on-the-job locations, or simulation facilities, are required. Students can use programmed instructional materials anywhere. Student rooms and lounges can be used for tape-slide presentations if students can be allowed to check out equipment.

(16) Course Organization. The chart depicts the way in which SDC intends to organize the IM course.

(15) Course Presentation Location. Check feasible locations.

__X__ classroom/laboratory.

__X__ at home.

____ special facility required. Explain for which kinds of materials.

(16) Course Organization. Show graphically and/or describe.

Blocks I-III	Block IV
5 Lesson Modules	8 Lesson Modules

Each lesson module contains:

Advance Organizer → Lesson Element → Lesson Review Element → Criterion Test Element → Evaluation Element

An End-of-Block Test will be prepared for use at the end of Block IV.

Legend:

Block = A major block of instruction.

Lesson Module = A self-contained unit and the smallest stand-alone component of the course.

Advance Organizer = Introduction to students of organizing concepts and of the skills and knowledge to be presented in the lesson element.

Lesson Element = Stimulus, response, feedback sequence. Includes enabling progress checks per ATC Reg 52-3.

Lesson Review Element = Review organizer and student review matrix.

Criterion Test Element = Test for master of module's learning objectives; satisfies requirement for criterion progress checks, per ATC Reg 52-3.

Evaluation Element = Diagnosis for remediate instruction, for students who have not mastered a module's learning objective.

Figure 20. Instructional Strategy Worksheet for the IM Course (Sheet 6 of 6)

SUBSTEP 8-2. PREPARE PROGRAM OF INSTRUCTION REFERENCE SHEET

Using the information from the materials produced in Steps 1 through 7 and the Instructional Strategy Worksheet, a Program of Instruction Reference Sheet is prepared. A portion of the IM course Program of Instruction Reference Sheet is shown below in Figure 21. Instructional materials developers can then receive a work package consisting of the Program of Instruction Reference Sheet, Task Flows, TAISs, Learning Objective Worksheets, Test Item Worksheets, Methods and Media Worksheets, and the Instructional Strategy Worksheet to use in producing instructional materials. The Program of Instruction Reference Sheet serves as an index to work package contents.

PROGRAM OF INSTRUCTION
REFERENCE SHEET

PHASE I Selected Lessons from Block I, II, III.

Lesson Module A: Master Cross Reference List

Tasks: See Task Flows _____to_____.

See Training Analysis Information Sheets _____to____.

Objectives: See Training Objectives Worksheets _____to_____.

Test Items: See Test Item Worksheets _____to_____.

Method & Media: See Methods and Media Worksheet Task Codes _____to_____.

Strategy: Strategy Worksheet, all items

Lesson Module B: Federal Supply Catalog

Tasks: See Task Flows _____to_____.

See Training Analysis Information Sheets _____to_____.

Figure 21. Portion of the IM Course Program of Instruction Reference Sheet

STEP 9: DEVELOP AND PRODUCE INSTRUCTIONAL AND SUPPORTING MATERIALS

Instructional materials are prepared in accordance with the instructional strategy worksheet, using the reference materials specified on the program of instruction reference sheet. For the IM course, each of the substeps described below was performed in sequence for each module of instruction. Several persons performed this step, each writing a group of modules, so all module drafts were sent to a technical editor who evaluated and revised the PI material as necessary, and to a publications editor who revised where necessary for consistency of style and format in the total package. (Figure 22 presents Step 9 and its Substeps.)

SUBSTEP 9-1. PREPARE INSTRUCTIONAL MATERIALS FOR EACH LEARNING OBJECTIVE AND TEST ITEM

The Methods and Media Worksheet specifies the basic instructional method and media for a given module. For the IM course, all modules utilize programmed instruction as a basic method, with some modules also utilizing practical exercises. Media utilized are actual objects, tape recorder, slide projector, and of course, print.

Materials developers began their production of the instructional materials by preparing lesson element materials first. To do this, the relevant task flow, TAIS, learning objectives worksheet and test items sheet for the module were reviewed. The developers then took the role of the IM student and worked through all of the current instructional materials just as the student does.

A series of PI frames were written for each learning objective of the lesson module. Drawings were rough-drafted, photos were copied, and these materials were inserted where appropriate. Humor and drawings were utilized where appropriate in the materials to enhance interest. Material from early tasks was utilized in subsequent tasks to reinforce responses learned earlier.

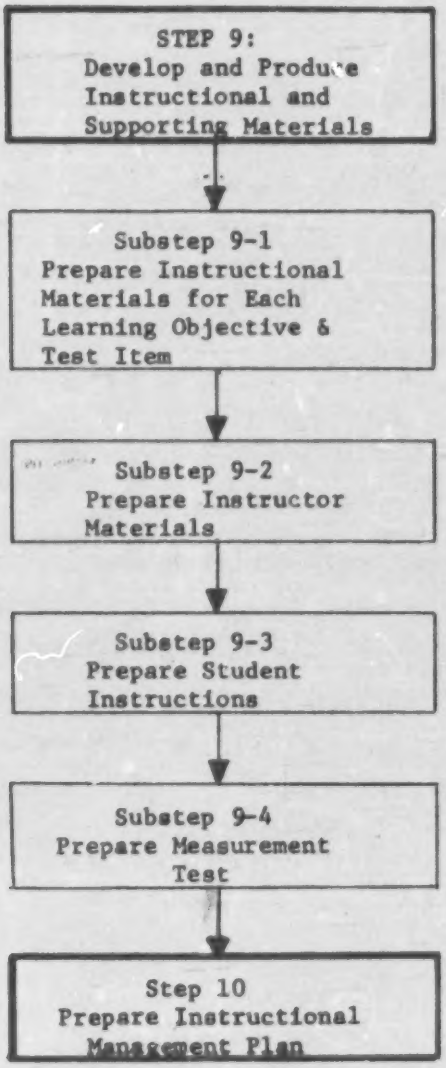


Figure 22. Substeps in Developing Instructional and Supporting Materials

Advance Organizer Materials

Advance organizers were prepared after lesson element production. For some lessons, advance organizers are entirely print. For others, tape and slide or tape presentations constitute the advance organizer element, depending on the media specified on the Methods and Media Worksheet.

An advance organizer presents basic concepts and procedures required for task performance. The advance organizer is designed to be viewed or read immediately before beginning the lesson element. It can be viewed again as part of the review element, prior to the review quiz. A portion of an advance organizer that utilizes the print medium is shown in Figure 23.

Tape and slide presentations were produced in-house by SDC. The simpler slides were prepared by the programmed instruction frame writers utilizing ordinary photographic equipment. Some slides were prepared by SDC's Cartographic Department, primarily those requiring greater artistic talent than was possessed by the instructional developer. Tape presentations were prepared utilizing a good quality cassette recorder. "Draft" versions were prepared utilizing a variety of untrained voices. Once content is reviewed and edited to optimize learning, an SDC employee with professional experience in movies and commercials will do the final narration.

It is beyond the scope of this report to discuss how programmed instructional materials should be written, or what constitutes a good frame. There are many good books available on the subject, however. A short list of books useful to beginners is contained in the References.

Lesson Element Materials

Lesson element materials were written first.

The lessons are in PI format. A lesson covers tasks to be performed, functions, equipment and materials involved, purposes of the task, and basic concepts and vocabulary.

Figure 24 shows an example of the programmed instructed format.

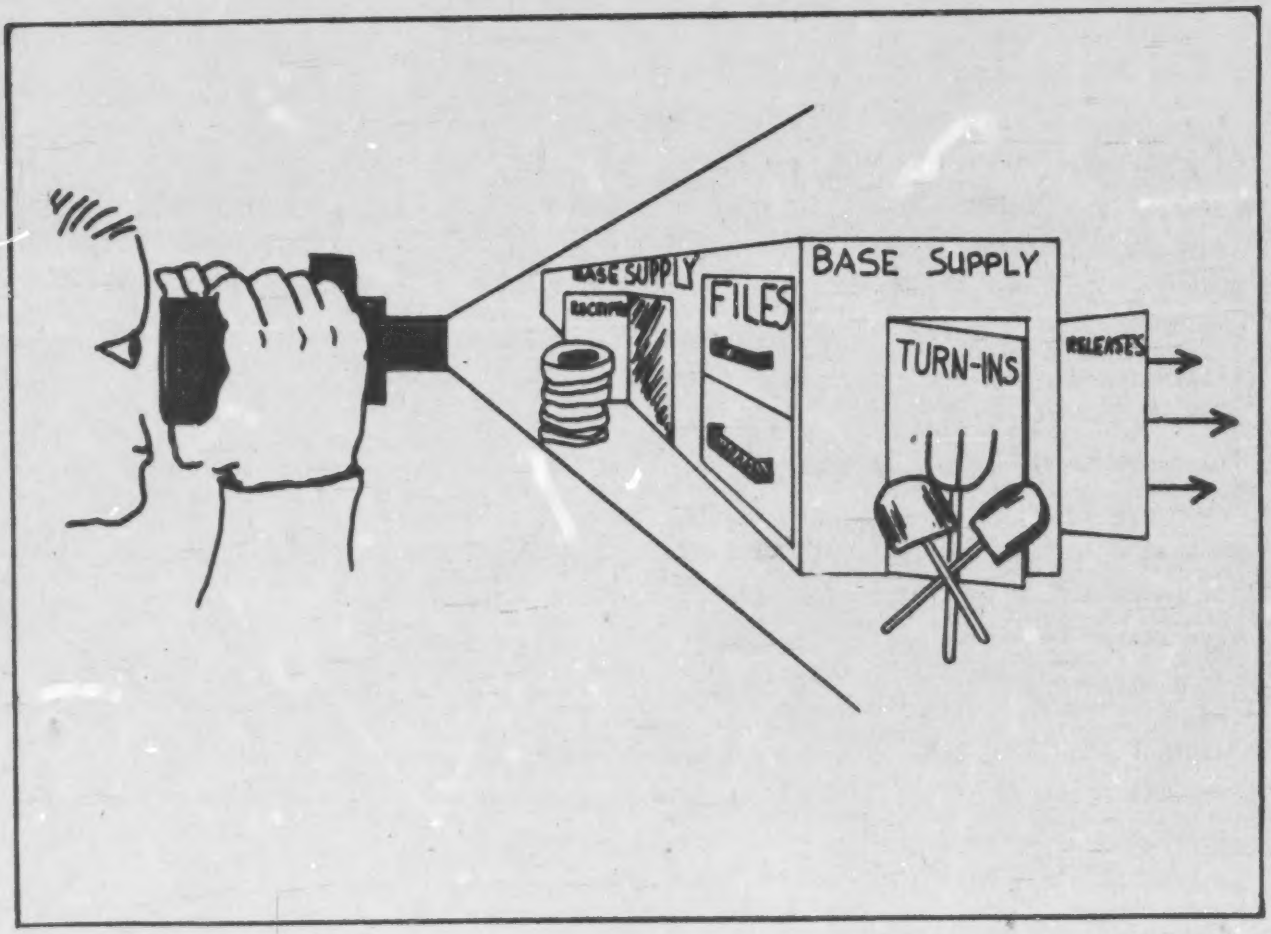


Figure 23. Portion of an Advance Organizer Utilizing the Print Medium

1. AF FORM 2005 GO TO 9:2

▲

2. MANUALLY, BASE SUPPLY

Sometimes, the head of a department will make a turn-in for the whole group. This person is called a Property Custodian. The property custodian completes another form before the AF form 2005 is filled out. This other form is filled out by the propoerty custodian before he makes the turn-in at Base Supply.

▲

3. Look at Figure 5. What form will the property custodian fill out if the shovels being turned-in come from him? AF form _____ is filled out by the property custodian before the shovels are turned-in to the Base Supply.

Figure 5.

▲

4. AF FORM 601b is correct.

Even though the property custodian filled out an AF form 601b, you still must complete an AF form _____ for the items he turned in.

▲

Figure 24. Portion of a Lesson Element

Review Element Materials

Review element materials were produced third. A review element starts with PI frames that direct the student to review the advance organizer element, and/or review lesson element subjects of the student's choice, and then take the review quiz. A subject review page lists the lesson's subjects and specifies their page numbers within the lesson element. The review quiz consists of the enabling test items from the Test Item Sheet. Answers are given at the end of the quiz, along with page/step references for review if answers are incorrect. A portion of a review quiz is shown in Figure 25.

The questions that follow summarize this lesson. Your task is to read each question and fill in any blanks with the appropriate word or words, or make the correct response to a multiple-choice question. You may use, if necessary, applicable publication(s) to aid you in answering the questions.

Complete the entries without referring to the lesson text. At the conclusion of these questions you will find a scoring key which you can use to check the correctness of your answers.

1. Identifying Procedures for Processing Receipts or Turn-Ins

1.1 Requested items that have been shipped from either requisition source or another source are called RECEIPTS _____.

1.2 To receive unrequested items from a source of supply is termed an _____ shipment.

1.3 If the equipment came from a property custodian, then he must have first filled out:

a. DD Form 1348-1

b. AF Form 601b

c. AF Form 2005

d. AFTO Form 350

1.4 What paperwork must accompany a DIFM item when it is being turned in to supply? Pick the letter(s) of your choice. _____

a. Part I AFTO Form 350

b. Part II AFTO Form 350

c. Copy 1 of DD Form 1348-1

Figure 25. Portion of a Review Quiz

Criterion Test Element Materials

Performance tests contain the criterion test items from the Test Item Sheet for the lesson. Figure 26 shows a portion of a performance test.

1. What are the two general sources for increasing base supply assets?

   _____ _____

2. The most common basis for a receipt is a (an):

   a. Requisition
   b. Transaction
   c. Expendable item
   d. Turn-In
   e. Turn-On

3. When property is returned to base supply, you must fill out:

   a. DD Form 1348-1
   b. AF Form 601b
   c. AF Form 2005
   d. CC 67-80
   e. AFTO Form 350

4. What is done when a partial receipt is processed.

   a. Do nothing
   b. Fill in the DD Form 423 interim sheet
   c. Modify the existing due-in card
   d. Output a new due-in card
   e. None of the above

5. For each requisition a receipt _____ card should be prepared.

6. Returning property to base supply is termed _____.

Figure 26. Portion of a Performance Test

Evaluation Element Materials

Because evaluation materials are used by the instructor to aid the student, they were prepared as part of the Instructor Materials production process discussed in Substep 9-2. Instructional Materials for each Learning Objective for the IM Course are shown in Table 4.

SUBSTEP 9-2. PREPARE INSTRUCTOR MATERIALS

An Instructor Guide was prepared for each lesson. This guide consists of three basic parts: a listing of required equipment and training materials, a sequential list of lesson events and related instructor activities, and the evaluation element for the lesson. The evaluation element consists of a scoring key for the criterion test, instructions on documenting test results, and several possible prescriptions for the student to follow, depending on criterion test score attained. The prescriptions direct the student to begin the next lesson, repeat the current lesson, or review specific subjects in the current lesson with the help of the instructor. A portion of the Instructor Guide is shown in Figure 27.

Table 4. Instructional Materials for each Learning Objective

	ELEMENT				
Lesson	Advance Organizer	Lesson Element*	Review Element	Criterion Test Element	Evaluation Element
Module A	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module B	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module C	Overview (tape, slide)	Programmed Instruction (print) Demonstration (actual object)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module D	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module E	Overview (print)	Programmed Instruction (print)	Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 1	Overview (tape, slide)	Programmed Instruction (print)	Subject Review (print)	Performance Test (print)	Instructor's Guide (print)
Module 2	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 3	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 4	Overview (tape, slide)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)

*Note: Included with the programmed instructional materials are a number of printed forms which constitute Actual Objects.

Table 4. (Continued)

	ELEMENT				
Lesson	Advance Organizer	Lesson Element*	Review Element	Criterion Test Element	Evaluation Element
Module 5	Overview (tape, slides)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 6	Overview (tape, slides)	Programmed Instruction (print)	Overview (tape, slide) Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 7	Overview (print)	Programmed Instruction (print)	Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)
Module 8	Overview (print)	Programmed Instruction (print)	Subject Review (print) Review Quiz (print)	Performance Test (print)	Instructor's Guide (print)

*Note: Included with the programmed instructional materials are a number of printed forms which constitute Actual Objects.

AIS INSTRUCTOR GUIDE

COURSE TITLE: Inventory Management Specialist LESSON MODULE: C-Remote Operations

EQUIPMENT

Slide Projector
Tape Recorder
1066 Remote Keyboard Printer

TRAINING MATERIALS

Slide/Tape Package
PI Package
Remote Package
Student Schedule

Lesson Events	Instructor Activity
1. Slide/Tape Presentation	Assist student, upon request, to initiate slide/tape presentation (presentation length: 15 minutes)
2. PI Text	On Demand
3. Controlled Practical Exercise	Instructor Demonstration: [1] Form Loading 1.1 Open upper cover 1.2 Insert first sheet of DD Form 1348-1 face down 1.3 Lift out-of-paper switch 1.4 Advance form under sprocket 1.5 Release paper bails 1.6 Turn manual feed-out knob to advance forms to first line of print 1.7 Snap paper bails back into place [2] Setting Vertical Tabulator 2.1 Pull knob out as far as it will go 2.2 Turn knob clockwise until one of the form out stops is directly under the detent 2.3 Push knob back in place

Figure 27. Portion of an Instructor Guide

SUBSTEP 9-3. PREPARE STUDENT INSTRUCTIONS

Student instructions were prepared to accompany each lesson. They are located at the beginning of the lesson booklet. Instructions include those for using programmed instruction materials, for operating tape and slide equipment, for starting and stopping the media presentation, and for beginning the lesson element. The instructions are in PI format. The student has the option to branch past the instructions for using PI materials and for operating equipment if he has had previous experience. Part of the first page of the student instructions for one module is shown in Figure 28.

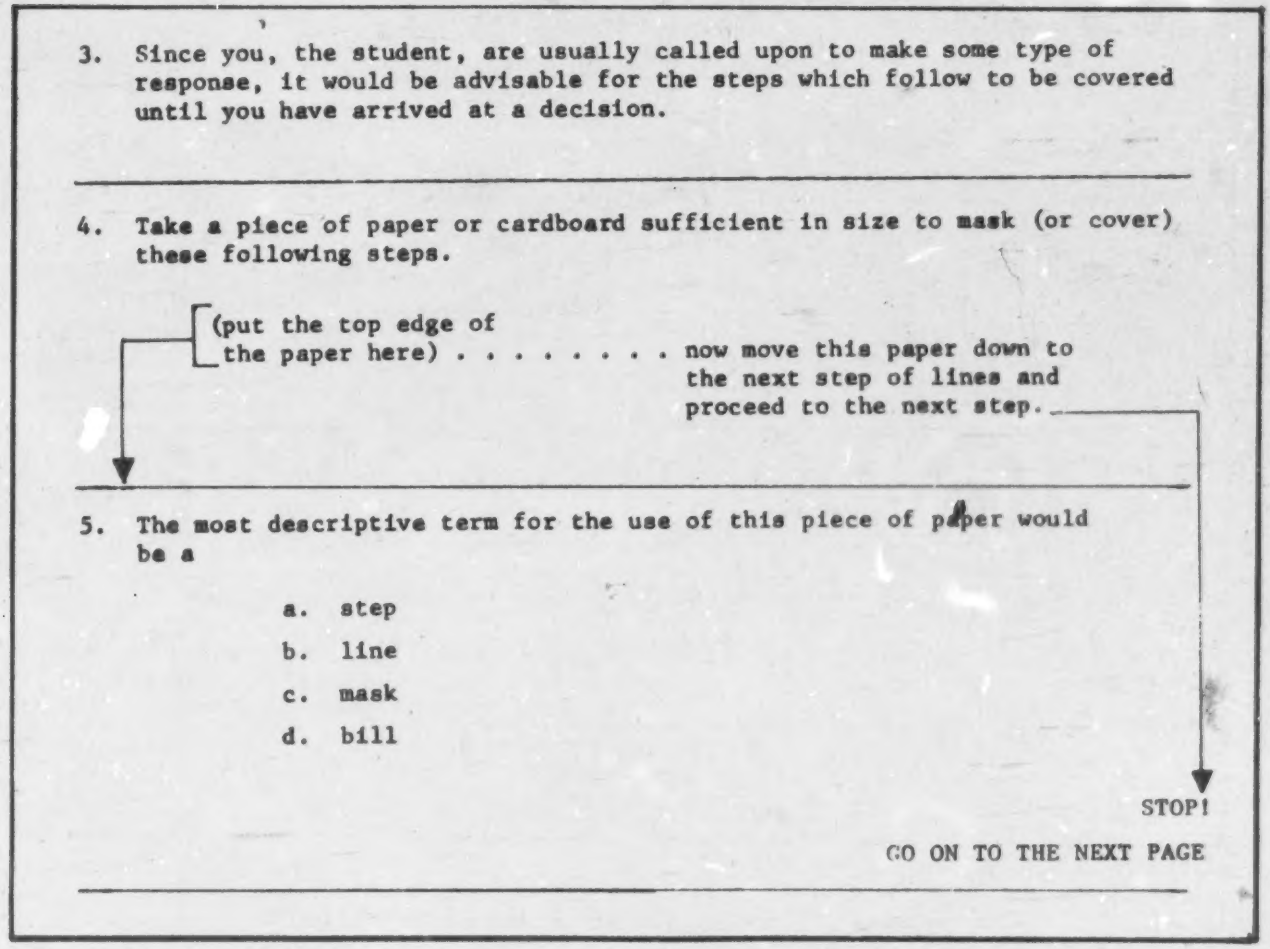

3. Since you, the student, are usually called upon to make some type of response, it would be advisable for the steps which follow to be covered until you have arrived at a decision.
4. Take a piece of paper or cardboard sufficient in size to mask (or cover) these following steps.
(put the top edge of the paper here) . . . . . now move this paper down to the next step of lines and proceed to the next step.
5. The most descriptive term for the use of this piece of paper would be a
a. step
b. line
c. mask
d. bill
STOP!
GO ON TO THE NEXT PAGE

Figure 28. Portion of Student Instructions

SUBSTEP 9-4. PREPARE MEASUREMENT TEST

A final measurement test was prepared for use at the end of Block IV, the final segment of the IM course. Block IV contains eight lesson modules, all of which were individualized. The measurement test, called an End-of-Block test, covers these eight lesson modules. Students must score 70 on the test to graduate from the course. The End-of-Block test was prepared to be compatible with the new lesson materials. A portion of it is shown in Figure 29.

3ABR64530-1 BLOCK IV ACADEMIC TEST

1. Desks and typewriters are examples of items with ERRC designators:

   a. XB2 and ND2
   b. XB3 and XD2
   c. ND2 and NF2
   d. XF2 and XF2

2. Which organization has primary responsibility for validating a request for equipment authorization?

   a. Storage and Issue Section
   b. Demand Processing Unit
   c. Request Validation Unit
   d. Allowance/Authorization Unit
   e. Any organization that gets stuck with the job

3. To make sure an allowance document is current, you would look in:

   a. AFR 0-10
   b. MEMI
   c. ASC Listing
   d. Guide to Allowance Documents
   e. Modern Health

Figure 29. Block IV Academic Test

STEP 10: PREPARE INSTRUCTIONAL MANAGEMENT PLAN

Management of self-paced individualized training courses is more complex than is management of a more traditionally structured course. When a course is self-paced, course and lesson completion times vary with the individual. The time that a student will be ready for job assignment cannot be predicted with certainty. The role and schedule of the instructor is affected also. An instructional management plan is needed well before the new self-paced materials are in official use in order to anticipate and resolve management problems, to enable the training school staff to familiarize themselves with their new roles and duties, and to set out a general plan by which training will be accomplished.

Instructional management planning is actually and iteractive process during the instructional materials development phase. Detailed plans for many factors that must be considered in the plan require coordination with the training school staff -- both administrative and instructional personnel -- and joint agreements that are compatible with constraints on training school resources must be reached. A considerable amount of informal research and analysis may be required in the investigation of possible schemes for scheduling students and allocating resources. For example, the question of where trainees will be physically located while using the instructional materials must be addressed in the plan. Planning personnel might initially propose that all lesson materials be physically located in one "check-out" room, only to find that the classrooms used for instruction are so dispersed physically that students would be spending a half hour a day checking materials in and out.

Of course, when instructional management planning personnel are physically located at the training school, are familiar with current management procedures, and have access to the administrative and instructional personnel whose duties and roles will be affected by implementation of the plan, problems like this diminish. If planning personnel are not located at the school, several visits are required to gather management planning information and to identify constraints and limitations that will affect planning.

For the revised IM course, instructional management will at first be manual, as is the management of the current IM course. Later, a computer system may be available which can aid in many of the management tasks. The instructional management plan must be suitable for instructional management before the computer system is operational.

Figure 30 shows the substeps involved in preparing an instructional management plan.

SUBSTEP 10-1. IDENTIFY MANAGEMENT FUNCTIONS FOR THE IM COURSE

The first step in development of an instructional management plan is to identify the management functions that must be performed within an instructional system that employs individualization of materials and self-pacing of students. For the IM course, SDC examined documentation for several such systems and constructed a list of functions that could be considered typical for these systems. The functions can be listed in four major categories: 1) functions related to student placement, scheduling, record keeping and report preparation; 2) functions related to instruction, presentation of materials, monitoring progress and daily counseling of students; 3) functions related to testing, assessing student progress, and planning of the student's learning activities; and 4) functions related to evaluating and revising the course and analyzing student performance.

The first column of Table 5 lists all of the typical functions abstracted for the literature searched.

Next, SDC examined each of the functions listed in column 1 of Table 5 to determine whether it was likely to be required when the IM course management will be aided by a computer system -- when the IM course will be part of the Advanced Instructional System (AIS). The Statement of Work for AIS was not available when this analysis was performed, so some revision may be required at a later date.

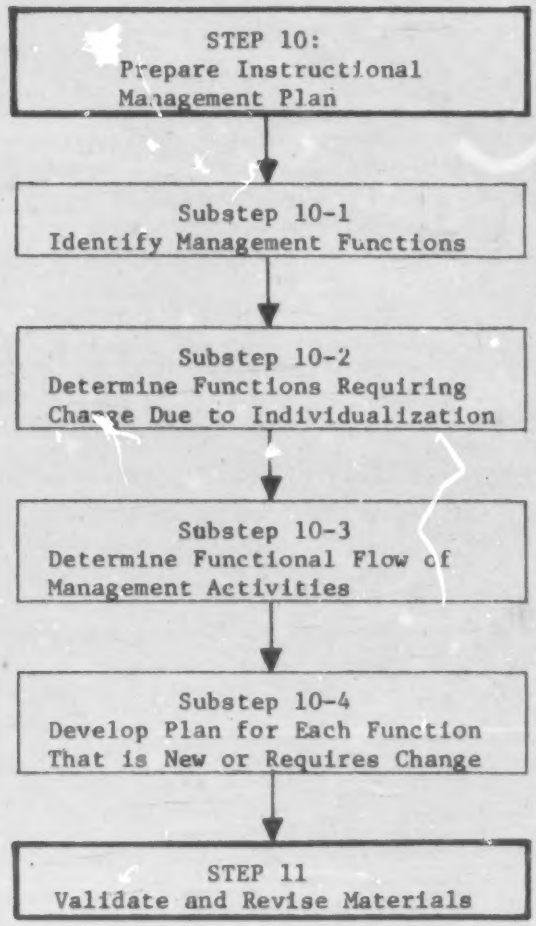


Figure 30. Substeps in Preparing Instructional Management Plan

Table 5 Selection of Management Functions for Inclusion in the IM Instructional Management Plan

(1) Typical Management Functions in an Instructional System	(2) Relevance to IM in a Computer-Managed Stage (Performed by Man/Machine System)	(3) Relevance to IM in a Manual Operation Mode	(4) Individualization's Effect on Current Performance of Function	(5) Decision to Include in IM Instructional Management Plan
Student Placement, Scheduling, Data and Record Keeping, and Report Preparation Functions				
• Collect student background data; create data base	Required*	Some data helpful in initially predicting completion date. Student ID data required.	No change	No
• Collect student characteristics data; create data base	Required*	Assuming student selection process currently used, only AQE and AFQT scores required.	No change	No
• Administer course pretest	Required*	Not required; aptitude requirements preclude lack of reading ability.	--	No
• Determine student start point in course materials	Required*	Not required; number of students with previous experience minimal.	--	No
• Create student profile and match with instructional resources	Required*	Not required; single set of resources for all students	--	No
• Estimate student course completion date	Required	Required	New	Yes
• Create and store student records	Required	Required	No change	No
• Prepare reports for student planning and scheduling	Required	Required	New	Yes

*Requirements may have minimal relevance to IM course. Student selection process for the IM course ensures a relatively homogeneous group in terms of mental ability, and Air Force training regulations ensure relative homogeneity also in terms of prior work or training experience.

Table 5 (Continued)

(1) Typical Management Functions in an Instructional System	(2) Relevance to IM in a Computer-Managed Stage (Performed by Man/Machine System)	(3) Relevance to IM in a Manual Operation Mode	(4) Individualization's Effect on Current Performance of Function	(5) Decision to Include in IM Instructional Management Plan
• Prepare evaluation data reports for use by course evaluators	Required	Desireable	Changed	No
• Maintain master test item retrieval system	Required	Not required; alternative items not available.	--	No
• Allocate and schedule resources and students	Required	Required	Changed	Yes
• Schedule students for job assignment	Required	Required	Changed	Yes
Instructional Functions				
• Conduct learning sessions, present materials, equipment	Required	Required	Changed	Yes
• Monitor student progress	Required	Required	Changed	Yes
• Furnish tutorial aid, counselling, revised plans, schedules	Required	Required	Changed	Yes
• Administer individualized incentive plans	Required	Desireable	New	No
Student Progress Assessment Functions				
• Administer criterion tests	Required	Required	No change	No
• Score tests, analyze student performance	Required	Required	No change	No
• Determine daily diagnosis and prescriptive options	Required	Required	New	Yes

Table 5 (Continued)

(1) Typical Management Functions in an Instructional System	(2) Relevance to IM in a Computer-Managed Stage (Performed by Man/Machine System	(3) Relevance to IM in a Manual Operation Mode	(4) Individualization's Effect on Current Performance of Function	(5) Decision to Include in IM Instructional Management Plan
• Assign course grades official report items	Not required	Not required	No change	No
• Update student records, planning reports	Required	Required	Changed	Yes
Course and Materials Development Evaluation and Revision Functions				
• Specify instructional strategies	Required	Not required; has been performed by SDC	--	No
• Perform research studies	Required	Desirable	Changed	No
• Monitor resources effectiveness and student performance	Required	Required	Changed	Yes
• Reduce and analyze student performance data, analyze course materials, analyze job; decide revisions	Required	Required	Changed	Yes
• Develop/revise task data, objectives, instructional materials; test items; prescriptive rules; instructor support materials	Required	Required	Changed	Yes
• Prepare and output evaluation results reports	Required	Required	No change	No

The second column of Table 5 shows our decisions as to the functions that will probably be required to manage courses like the IM course when the AIS is operational.

Third, SDC decided which of the functions in column 1, of Table 5 , would need to be performed for the IM course when it is being managed in the manual mode. Here we made some assumptions about how students would be selected for the course, the extent to which the course might be revised due to changes in the job, and so on. Column 3, in Table 5, shows the decisions made. A major decision was to develop a "bare-bones" management plan for the manual phase. In this way, the manual management system will not be overloaded with record keeping and data collection tasks that, while easy to perform in a computer-aided system, require a large staff to perform manually. Therefore, functions for which the column 3 decision is "desirable" rather than "required" are not included in the manual management plan.

SUBSTEP 10-2. DETERMINE FUNCTIONS REQUIRING CHANGE DUE TO INDIVIDUALIZATION

For this substep, SDC decided which IM functions for the manual mode (those in column 3 of Table 5) were new, that is not now being performed, or would require changes in procedure from the way they were now being performed. Column 4 in Table 5 reflects these decisions. The final column in this table, column 5, shows a Yes or No decision as to whether new planning is required for each function. Functions that are new or need changes have a Yes decision. Functions that can be performed essentially as they are performed now have a No decision, as do functions not required. Functions with a Yes decision are those decisions to be described in detail in the manual Management Plan.

ASSUMPTIONS FOR THE MANUAL MANAGEMENT PLAN

Assumptions for the IM Course are briefly described as follows:

- No computer capability available for aiding in performance of management functions during the manual phase.
- Functions not requiring change due to individualization of the IM course will continue to be performed as they are performed now.
- Selection of students for the course will continue to be on the current basis.
- Course objectives, task analysis, and instructional strategy will not require extensive revision due to job changes during the manual phase.
- Large-scale data collection and report preparation activities, so easily accomplished in a computer-aided system, are not appropriate for the IM course in the manual phase. These activities must be kept to the minimum required to assess student performance and provide basic course evaluation data during the manual phase to avoid staff overload.
- Complex adaptive modelling and prescriptive algorithms are not appropriate to the manual phase either. These functions must be kept relatively simple until computer assistance is available.

SUBSTEP 10-3. DETERMINE FUNCTIONAL FLOW OF MANAGEMENT ACTIVITIES

In order to plan how IM management functions can be performed in the manual mode, and to aid managers in organizing these activities, SDC prepared a functional flow chart of all the management functions, including those not requiring changes. Column 3 of Table 5 was used as the baseline set of functions for this activity. Functions for which the notation "Required" appears are those included in the flow chart. Figure 31 shows the flow chart. the functions that are new or require change are outlined with heavy black boxes in Figure 31. Functions that can be performed essentially as they are performed now appear with thin black lines around the boxes.

Next, SDC specified for each function the type of person most likely to perform it and the activities or tasks performed as part of the function. Table 6 shows a part of this analysis, for the student placement, scheduling, record keeping, and report preparation functions. Specifying the activities for each function enabled us to see where new management aids, such as logs, report forms, or decision-making rules, would be required, and to check to be certain that functions thought to require no changes could be performed without new aids or procedures.

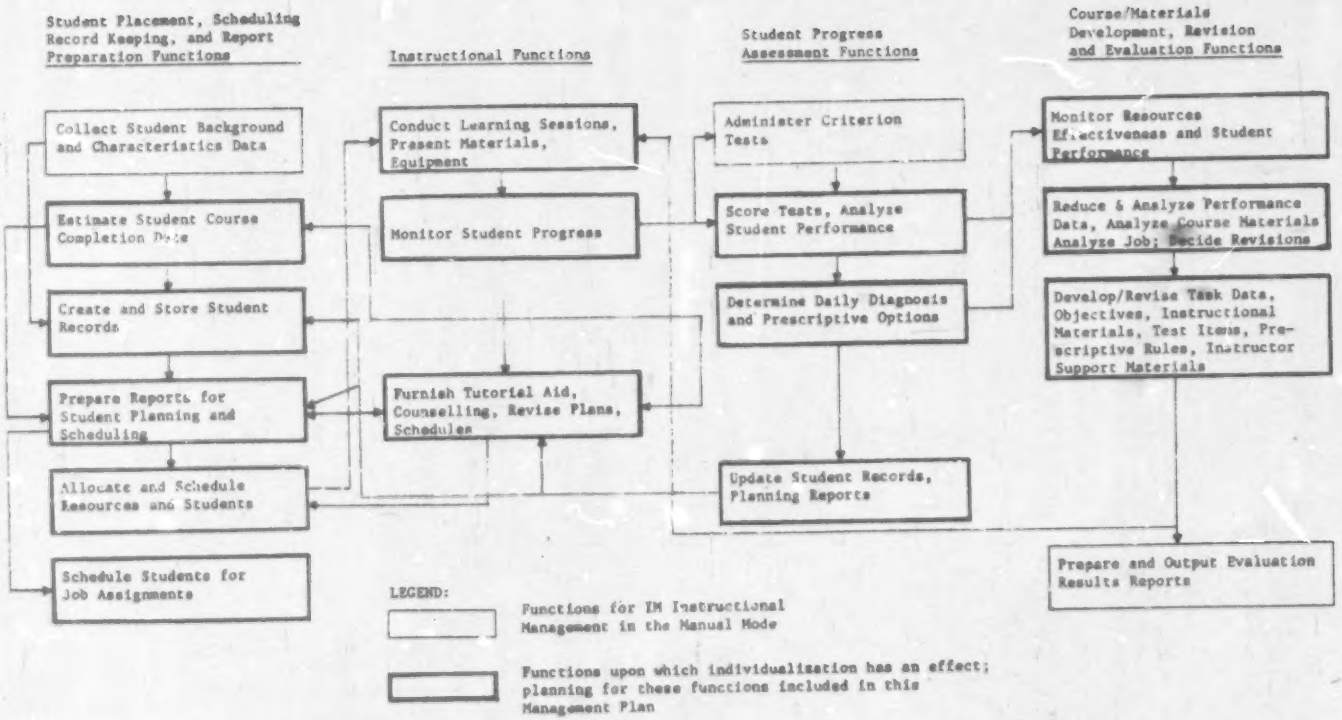

Student Placement, Scheduling Record Keeping, and Report Preparation Functions
Instructional Functions
Student Progress Assessment Functions
Course/Materials Development, Revision and Evaluation Functions
Collect Student Background and Characteristics Data
Estimate Student Course Completion Date
Create and Store Student Records
Prepare Reports for Student Planning and Scheduling
Allocate and Schedule Resources and Students
Schedule Students for Job Assignments
Conduct Learning Sessions, Present Materials, Equipment
Monitor Student Progress
Furnish Tutorial Aid, Counselling, Revise Plans, Schedules
Administer Criterion Tests
Score Tests, Analyze Student Performance
Determine Daily Diagnosis and Prescriptive Options
Update Student Records, Planning Reports
Monitor Resources Effectiveness and Student Performance
Reduce & Analyze Performance Data, Analyze Course Materials Analyze Job; Decide Revisions
Develop/Revise Task Data, Objectives, Instructional Materials, Test Items, Prescriptive Rules, Instructor Support Materials
Prepare and Output Evaluation Results Reports
LEGEND:
Functions for IM Instructional Management in the Manual Mode
Functions upon which individualization has an effect; planning for these functions included in this Management Plan

Figure 31. IM Course Management Functional Flow

Table 6. Functions for IM Instructional Management

Functions	Type of Personnel Performing	Activities
Student Placement Scheduling, Record Keeping, and Report Preparation Functions:		
• Collect student background data	Administrative	Obtain AFQT, AQE scores and previous experience and training from service records.
• Collect student characteristic data	Instructors	Use background data to estimate course completion dates
• Estimate student course completion date	Administrative	Create file of service records. Create and include other official course records.
• Create and store student records	Instructors	Use student records, estimated completion date, and progress reviews to prepare working record of performance and progress summary, revisions to completion dates, significant prescriptions, problems.
• Prepare student reports for planning and scheduling	Administrative, Instructors	Create rosters, logs, and schedules; use to allocate students and resources.
• Allocate and schedule resources and students	Administrative	Use student report to estimate time student can be available for job assignment.
• Schedule students for job assignments		
Instructional Functions		
• Conduct learning sessions, present materials, equipment	Instructors	Give demonstrations, supervise practical exercises, ensure that student has access to instructional materials, instructional equipment.
• Monitor student progress	Instructors	Observe student progress within each lesson, review test results, observe practical exercises.
• Furnish tutorial aid, counselling revise plans, schedules	Instructors	Supplement materials, answer questions, counsel students, estimate student needs for resources.

SUBSTEP 10-4. DEVELOP PLAN FOR EACH FUNCTION THAT IS NEW OR REQUIRES CHANGES

Column 5 of Table 5 determined which functions would require management planning. Each of these functions is described in the management plan, as they will be performed in the manual mode of operation. New report forms and other management aids are included in the descriptions. The manual management plan for the IM Course is located in Appendix C.

Some Comments on Management Planning

Some changes to an instructional system require policy decisions rather than pure technical decisions. Policy decisions must be made by school administrative personnel and other management personnel rather than by technical planners. An example of this kind of system change involves deciding how to schedule students who complete the course early, which is very likely to occur in the IM course. Should these students be given leave until the normal time for job assignment? Should they be used as course tutors for slower students? Technical planners can furnish information about the probable consequences of each alternative for the use of others in making this kind of decision, but the decision itself is a matter of policy.

One of the most important areas to consider in management planning for a self-paced individualized instructional system is that of scheduling and allocating resources, and scheduling and locating students. Students will be completing self-paced lesson modules at different times and will require practical experience training on an irregular schedule. Students may not be physically located in a particular classroom all day. Unless a system is devised for organizing information about the availability of resources and the needs of students for these resources, a self-paced course will be too chaotic for the instructor to offer help with course content when such help is needed. A log showing the location of each student in the class is a necessity. A resource planning aid is also a necessity, enabling the instructor to anticipate the needs of his students and make needed resources

available to them. For most self-paced courses, money is not available to provide each student with full-time use of tape, slide, movie, or TV equipment, and indeed the student does not require full-time use of this equipment in the IM course. But, if the student cannot have access to such equipment when he needs it, the main advantage of self-pacing is lost, and students lose incentive to proceed as quickly as they can through the course.

A long delay in performance testing has a bad effect also. Some forgetting is normal after learning. A delay in testing for some students and not for others puts the students suffering the delay at an unfair advantage. A daily scheduling log can be designed to overcome many of these problems. Ideally, it can be tried out on a dry-run basis and perfected before its use in the classroom setting is required. An instructional management plan must address itself to solving those kinds of problems.

STEP 11: VALIDATE AND REVISE MATERIALS

Once learning materials are developed, they must be tried out and then revised before they are used in training courses. Almost always it is found that some instructional frames and test items are misunderstood by a significant portion of the group participating in the validation tryout and thus require revision. (Figure 32 presents Step 11 and its substeps.)

The validation and revision process is a cyclical one. When revisions have been made, substep 11-4, then a new validation plan is developed to test the effectiveness of the revisions.

For the IM course the validation was performed manually -- without computer assistance. Where computer assistance is available, as it will be in the completed AIS, validation data can be stored and processed using the computer and suitable programs. (see Appendix D for Validation Study & Data.)

SUBSTEP 11-1. DEVELOP VALIDATION PLAN

Development of a plan for performing validation and revision is a crucial step in the validation process. A number of elements must be considered in the plan, each of which is discussed below.

Purpose of Validation

Two major purposes are possible for the kind of validation that is performed before materials are officially in use in a training course. These purposes are: 1) to improve instructional frames, test items, supporting materials and procedures so that they will be understood by most trainees and instructional personnel, and 2) to assess trainee performance, learning rates,

STEP 11:
Validate and
Revise Materials

Substep 11-1
Develop Validation Plan

Substep 11-2
Conduct Evaluation

Substep 11-3
Determine Findings and
Revisions Required

Substep 11-4
Make Revisions

STEP 12:
Prepare
Cost Analyses
Report

Figure 32. Substeps in Validating and Revising Materials

training times, efficiency of scheduling, and use of resources to make it possible to compare the effectiveness of the new materials with the old or with other sets of new materials and to aid in developing an effective management plan for the course.

For the IM course validation, SDC chose to plan the validation for both purposes. Therefore, planning included specifying data to be gathered and evaluation measures to be used that could be utilized for improvement of the materials and assessment of student performance and instructional management.

Method of Conducting Validation

Several basic methods are possible for conducting a validation. Ideally, instructional materials would be validated using a large group of actual trainees in the course for which the new materials are being prepared, and the procedures, facilities, instructional personnel and so on would be those actually occurring in the course environment. Practically, it is difficult to gather all of these resources for the first validation to be performed. Also, trainees participating in such a validation study may not be adequately trained by the yet-to-be revised materials, which makes it difficult for training administrators to give their permission for such an experiment. Further, such a full-scale validation process is expensive and time consuming -- usually too much so for totally untried materials. Therefore, initial validation trials are usually accomplished on a smaller scale.

For the IM course, SDC planned a three stage validation process. These stages were as follows:

- Stage 1. Individual assessment and critiques, wherein lesson tryouts and comments by non-Air Force personnel naive to the IM materials are used to make revisions prior to field trials.

- Stage 2. Small group field tryouts by IM students, and critiques by ATC specialists. Item/frame analyses of student responses and comments are performed. Performance scores and learning times are analyzed for each lesson element. Review comments from a group critique by instructors and job specialists are analyzed also. Analysis results are used to revise lesson materials, instructions, and test items and to aid in firming up an instructional management plan. SDC used seven groups of four students each to try out each lesson in this phase. Within the Block I-III lessons, each of five groups tried one lesson only. Within block IV, one group tried two lessons and the other group tried six lessons.

- Stage 3. Group field tests, supported by ATC instructors. Portions of the course that are to utilize the new materials are conducted much as if the new materials were officially in use. A major purpose of this stage is to verify the effects of Stage 2 revisions on student performance, learning rates, and attitudes. Another important purpose is to test the operational integration of course elements; in particular, to identify problems and to shake down personnel requirements and procedures, equipment, and training management functions. SDC used 20 students in this stage, each of which tried all block IV materials.

Validation Measures, Data Items, and Data Collection Instruments

Three validation elements -- validation measures, data items, and data collection instruments are all firmly linked together in a validation plan. The purposes of the validation determine to some extent the kinds of validation measures required. Once these measures are fully specified, the types of data to be collected are also determined. When types of data are determined, data collection instruments must be developed. These instruments must be appropriate for the kinds of data to be collected and the measure to be used, and also for the physical environment in which the validation will take place and for the resources and funds which can be expended for validation purposes.

For Stage 1 of the IM course materials validation, SDC planned only an informal collection of data. No formal validation measures were specified and no data collection instruments developed. Validation team personnel distributed materials to interested colleagues who volunteered to serve as "students". Each "student" worked alone through the materials, making notes as he progressed. As he completed the materials, he critiqued them for one or more members of the validation team. Validation team members then made revisions to materials on the basis of the critiques and on the performance of the "students" on the individual items in the materials.

For Stages 2 and 3 of the IM course materials validation, planning was more formal. The following types of data items were collected:

1. Elapsed time spent on each lesson for each student.
2. Each student's answers on enabling and criterion test items.
3. Number of wrong answers per student on each enabling and criterion test.
4. Student attitudes toward the materials and the individual mode of instruction.
5. Critique comments from IM course instructors.
6. Student background information, such as age, AQE score, and prior experience of training relevant to inventory management.
7. End of Block test scores (Stage 3 only).

All of these, except the last, serve a purpose in determining the kinds of revisions needed to materials and associated procedures. The student background information was collected for possible later use in relating student AFQT/AQE scores and experience to course time completion data or performance data.

Several data collection forms were developed for use in the Stage 2 and Stage 3 validation trials. No special data collection form was required for recording each student's answers on enabling and criterion test items --

copies of the instructional materials were used for this purpose. Elapsed time spent on each lesson element (separate times for each element were collected for Stage 2 only) was recorded on a form like that shown in Figure 33, in which times are shown in minutes and seconds.

Lesson	A				B				C			
Student	1	2	3	4	5	6	7	8	9	10	11	12
PI INTRO.	10	2	13	10	6	6	6	7	7	8	12	8
SLIDE INTRO.	5	7	3	6	-	-	-	-	-	-	-	-
ADV. ORG.	19	19	19	19	22	22	22	22	28	28	28	28
TEXT	48	45	1:50	50	2:37	2:21	2:39	2:13	1:13	1:26	1:38	54
BREAKS	10	10	10	10	30	30	30	30		10	10	10
REVIEW	0	0	0	1	19	31	3	1	3	0	2	6
ENAB.	9	13	9	11	1:05	41	35	25	18	11	14	13
PERF.	7	8	-	3	:34	29	28	27	-	0	-	-

Figure 33. Student Learning Times Recording Form (Stage 2)

Figure 34 shows part of the attitude questionnaire that was administered.

5) UNDERSTANDABILITY OF MATERIAL (Sheet 2 of 2)

Couldn't have been easier		Better than average		Understandable			Could have been more Understandable			Totally Impossible
10	9	X 8	7	6	5	4	3	2	1	Ø

6) HOW WELL WAS MATERIAL TAUGHT

Couldn't have been better		Very well		A v e r a g e			Rather Poorly			Learned Nothing
10	9	8	X 7	6	5	4	3	2	1	Ø

7) HUMANIZATION OF MATERIAL

Perfect		Very Human		Almost Right			Not much Feeling			Completely Devoid of any Feeling
10	9	X 8	7	6	5	4	3	2	1	Ø

8) FEEDBACK

Extremely Helpful			Very Helpful		Of Average Help		Not too Meaningful			Absolutely No Help
10	9	8	X 7	6	5	4	3	2	1	Ø

9) SLIDE/TAPE

☐ N/A

	Essential		Average		Not Much Use	Of No Value
1st Presentation	5	4	3	2	1	Ø
2nd Presentation	5	4	3	2	1	Ø

DID YOU USE THE REFERENCES ASSOCIATED WITH THE KEY TO THE REVIEW QUIZ?

[YES] [NO]

Figure 34. Portion of Attitude Questionnaire

A portion of the background data questionnaire is shown in Figure 35.

NAME_____ GRADE_____ TIME IN GRADE_____

SERVICE NO._____ AFQT SCORE_____

AGE_____ EDUCATION_____
(GRADE COMPLETED OR DEGREE)

AFSC_____

AQE (Airman Qualifying Exam) Scores:

Administrative _____

General _____

Electronic _____

Mechanical _____

Experience:

1. Total years/months in military _____
2. Total years/months in Supply Career Field_____
3. Have you had:
   a. Supply Helper Experience
      (1) Months _____ (2) AFSC_____
      (3) What did you do? _____

Figure 35. Portion of the Background Data Questionnaire

The following primary validation measures were planned for the Stage 2 validation:

1. Mean proportion of items correct, per lesson.
2. Mean proportion of time saved (over existing lesson time) per lesson.
3. Median attitude rating, for each lesson, for each attitude question, and over all lessons and questions.

For Stage 3, the same validation measures were planned and several others were added:

1. Performance improvement, Stage 2 to Stage 3, per lesson and over all Block IV lessons. Differences in lesson mean scores were used to calculate these measures.
2. Time saved improvement (over Stage 2 time saved) per lesson and over Block IV lessons.
3. Number of students receiving remediation per lesson.
4. Mean End of Block test score.

Analysis Plans

Data analysis plans are largely dependent on data to be collected and validation measures selected. Data analysis forms should be developed during the validation planning so that analysis can proceed smoothly when data are available. Forms must be carefully designed to minimize errors that can occur in combining data. If keypunching or optical scanning are going to be used to input data to a computer, forms should be specially designed for this purpose. SDC had a relatively small amount of data for the IM course validation and so it was decided that manual analysis, aided by electric calculators, would be most cost-effective to reduce data for analysis. Analysis forms were therefore designed for this use. Figure 36 shows the form developed to summarize student performance data and record results of measurement.

B-1

STUDENT PERFORMANCE SCORES

LESSONS 1-8, BLOCK IV

Lesson	ENABLING		CRITERION		Student	TOTAL		Lesson Mean Score
	No. Wrong	% Correct	No. Wrong	% Correct		Wrong	Mean % Correct	
1	N/A	N/A	6	71	1	6	71	77
			6	70	2	6	70	
			2	90	3	2	90	
			5	76	4	5	76	
Item N=			21			21		
2	9	67	12	65	1	21	66	72
	5	81	14	59	2	19	69	
	2	93	6	82	3	8	87	
	9	67	12	65	4	21	66	
	27		34			61		
3	2	91	2	93	5	4	92.5	85
	3	87	5	83	6	8	85	
	6	74	5	83	7	11	79	
	4	83	5	83	8	9	83	
Item N=	23		30			53		
4	4	78	2	91	5	6	85	88
	3	83	0	100	6	3	93	
	4	78	0	100	7	4	90	
	5	72	1	96	8	6	85	
Item N=	18		23			41		
5	4	86	0	100	5	4	93	89
	7	76	0	100	6	7	87	
	8	72	0	100	7	8	85	
	4	86	1	96	8	5	91	
Item N=	29		26			55		
6	13	64	2	95	5	15	80	79
	10	72	2	95	6	12	84	
	16	56	1	97	7	17	77	
	13	64	7	82	8	20	73	
Item N=	36		39			75		
7	4	80	4	64	5	8	74	70
	4	80	5	55	6	9	71	
	6	70	4	64	7	10	68	
	4	80	6	45	8	10	68	
Item N=	20		11			31		
8	0	100	4	67	5	4	79	87
	0	100	2	83	6	2	89.5	
	0	100	0	100	7	0	100	
	0	100	4	67	8	4	79	
Item N=	7		12			19		

Figure 36. Summary of Student Performance Data Form

The forms shown in Figure 37 were used to summarize student learning times and to calculate percent time saved over time in current classes. Times for current classes are shown in parenthesis above the summary form.

Lesson	A				B				C			
TOTALS	(3 HRS.)				(12 HRS.)				(3 HRS.)			
INTRO	15	9	16	16	6	6	6	7	7	8	12	8
MATERIAL	1:17	1:14	2:19	1:20	3:48	3:44	3:34	3:06	1:54	2:04	2:18	1:38
TESTS	16	21	16	14	1:39	1:10	1:03	52	18	11	14	13

	A				B				C			
% SAVED	57	59	23	56	68	69	70	74	37	31	23	40
M % SAVED	49%				70%				34%			

Figure 37. Summary Forms for Student Learning Times and Percent Time Saved

Figure 38 shows how student attitude data were summarized.

	1	2	3	4	5	6	7	8	Median Totals	# Pts on Scale
Lesson Length	7½	6½	6½	8	7	7½	7½	7½	7½	10
Technical Level of Material	7½	7	7	8	7	7	7	8	7	10
Teaching Approach Used	6½	5½	6½	7	7½	7½	7½	8½	7½	10
Material Holds Interest	9	7½	7½	8½	8	7½	8	8½	8	10
Understandability of Materials	6	6	6½	7	7	6	6	8	6½	10
How Well Taught	7	5½	7	8	7½	7	6½	8	7	10
Humanization of Material	7½	4½	6	7½	7	6½	6½	7½	6¼	10
Feedback Utility	6½	6½	7½	8½	7	6½	6½	7½	6¾	10
Utility of Slide/Tape Presentation		5	3	3	3½	4			3½	5
		5	4½	5	4½	4½			4½	5
Median Totals (Not including slide/tape)	6¼	6½	6¾	8	7	7	6¼	8	7	

Figure 38. Student Attitude Data Summary Form

Item Analysis and Materials Revisions Plans

A major purpose of the validation tryout is to provide data and information to enable instructional materials developers to make appropriate revisions to the materials. Data and information useful for this purpose include all of those discussed earlier in this Step. In addition, student performance on each frame and test item should be analyzed to determine the items on which students perform poorly. A standard or criterion must be set to define "poor" performance. Generally, for self-instructional materials, a "good" test item is one that is missed or answered incorrectly by no more than 15% of the students. SDC could not use this criterion for the IM materials in the Stage 2 validation because only four students performed on any given item. Therefore, for the Stage 2 validation when an enabling or criterion test item was missed by one or more of the students or when the mean percentage of correct items for a lesson was less than 85%, then the lesson or test item and its associated instructional frames were considered candidates for revision. For the Stage 3 validation, when an enabling or criterion test item was missed by three or more students (85% of 20), or when the mean percentage of correct items for a lesson was less than 85%, the lesson or item and associated frames were considered candidates for revision. Example of the item analysis matrices are located in Appendix D.

A standard should also be set to define "poor" learning times. In the military a general rule of thumb for this definition is that good self-paced individualized instructional materials should reduce learning time by at least 30% in comparison to the time allotted for the more traditional classroom/laboratory method. SDC used this rule of thumb in setting a learning time standard for each lesson -- mean time (over students) saved must equal at least 30% or the lesson would be a candidate for revision.

A criterion or standard can be set with respect to attitude data too. SDC decided that for the Stages 2 and 3 validations, median attitude ratings for each lesson should be at least at the scale midpoint or the lesson would be a candidate for revision.

One of the most difficult aspects of the validation and revision process is to determine exactly what items should be revised -- and in what way -- to improve performance. An analysis of the incorrect answers to test items provides valuable clues to identifying problems within the materials. Analysis of student performance on instructional frames provides additional clues. SDC planned these kinds of analyses for the IM Materials. Figure 39 shows the data sheet that was used to record incorrect responses to test items. Blanks in the form indicate that there were no incorrect responses for a particular item.

ENABLING CRITERION X

8 LESSON

IV BLOCK

TEST ITEM ANALYSIS

	3	6	7	8	9	WRONG	%
BRINKMAN	E		WRM ITEMS	D ONLY	B ONLY	4	67
CRAWFORD	E			C ONLY		2	83.5
DAY						0	100
DILLON	E	B		BC	E	4	67

Figure 39. Item Analysis Recording Form.

SDC planned to revise instructional materials on the basis of the Stage 2 validation. The revised materials would then be used in the Stage 3 validation and further revisions would then be made as required by results of the Stage 3 validation.

Planning the Conduct of the Validation Trials

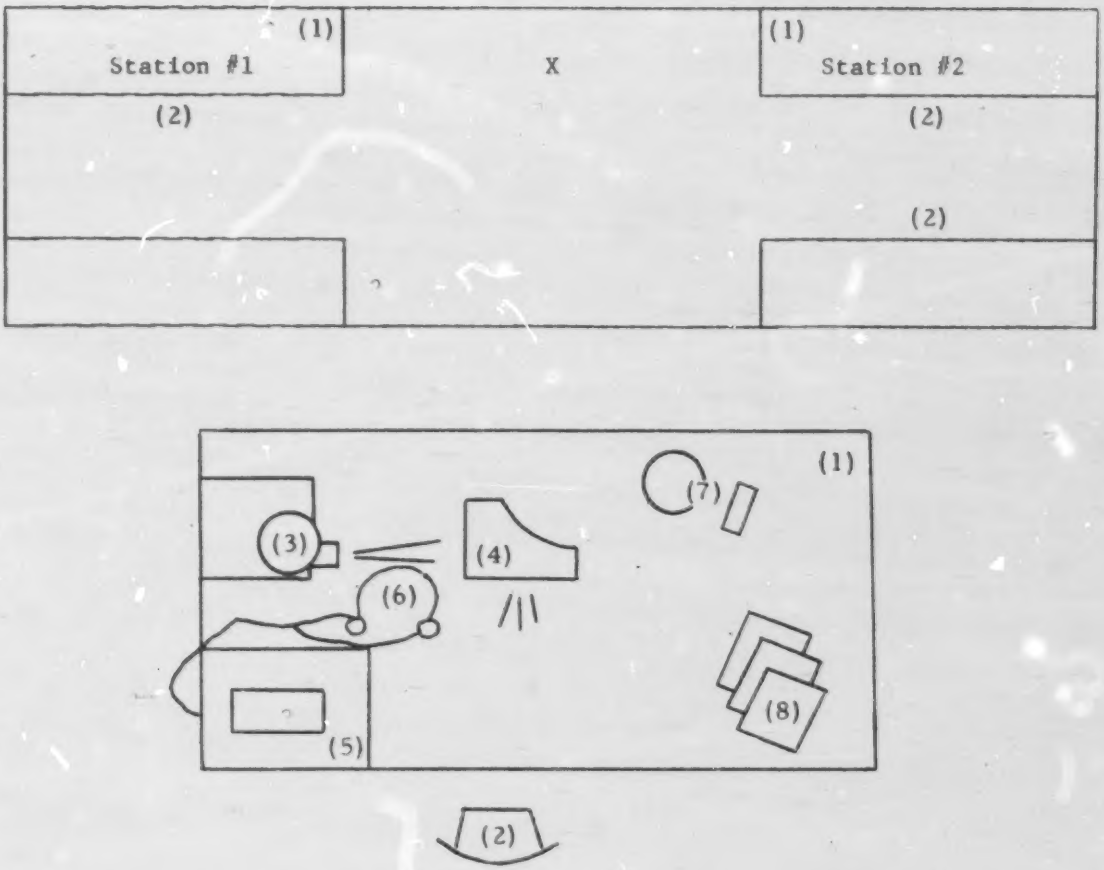
The conduct of the validation trials must be carefully planned and coordinated with the administrative and instructional staffs responsible for the course for which materials are being prepared. The following factors must be considered:

- Student flow and scheduling
- Resources allocation and usage
- Numbers and characteristics of students required
- Constraints on time, funding, and logistics
- Roles of validation team members and instructional staff members
- Administration and monitoring procedures

For the IM course, SDC developed test conduct plans for the Stage 2 and Stage 3 validation trials.

Stage 2 Validation Trials

For the Stage 2 validation, small group field tryouts, SDC planned to administer the Block I-III lessons to IM specialist course students at Lowrey AFB, four students per lesson, with one SDC observer monitoring two students for each tryout. The block IV lessons were to be administered to two groups of four students, each student undertaking a sequence of lessons. All students were to be selected by the Air Force from the ongoing course. One classroom was to be used for all sessions. Figure 40 shows the room configuration used.



X SDC observer

(1) Table 30" x 45"

(2) Student seated

(3) Kodak Carousel slide projector

(4) HPI Telescreen "T", Model #605T Rear projection screen

(5) Wollensak Slide-Synch Audiovisual Cassette Playback Unit

(6) Wollensak monophonic headphone, Model A-0483

(7) Loaded slide tray and audio cassettes

(8) Student instructions, Pi text, tests, etc.

Figure 40. Classroom Configuration for Stage 2 Validation Trials

Plans for monitoring and administering the Stage 2 trials were as follows:

- Brief students about the validation.
- Administer, collect, and check background information forms
- Monitor instructional materials trial, recording beginning and ending clock time for each lesson element, answering student questions and recording student difficulties.
- Observe student scoring of enabling tests. (Criterion tests were scored later by the validation team.)
- Administer attitude questionnaire and the ATC Programmed Instruction Critique (Form 3ABR64530-1).
- Give instructional materials to ATC instructors and job specialists for critique (materials to be reviewed and mailed back within two weeks).

Stage 3 Validation Trials

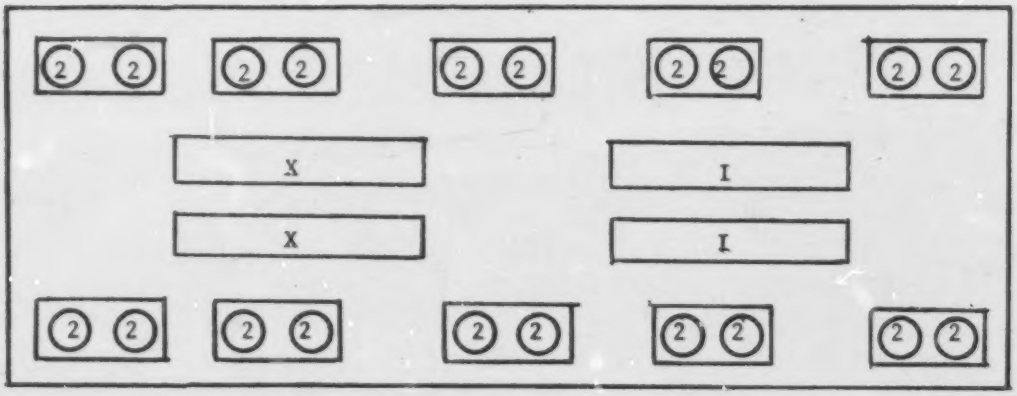
For the Stage 3 validation trials SDC planned to administer the Block IV lessons to 20 IM specialist course students at Lowrey AFB, in conditions approximating those in which the lessons would actually be used. All students were to be selected by the Air Force from the ongoing course. Two classrooms were used for the sessions, one of which was used only for the audiovisual equipment. Remedial instruction was given in both rooms. Figure 41 shows room configuration used.

The validation team was to consist of two SDC project members and two ATC instructors. Plans for monitoring and administering the Stage 3 validation trials were as follows:

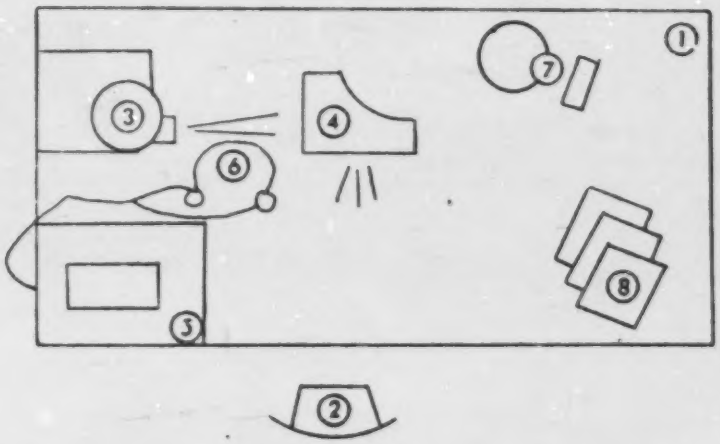
- Brief students about the validation.
- Administer, collect, and check background information forms.
- Monitor instructional materials trial, recording beginning and ending time for each lesson, answering student questions and recording student difficulties.
- Score criterion test.
- Administer attitude questionnaire.
- Administer end of block test.

Figure 41 shows the room configurations used.

Classroom Configuration



Audio Visual Room Table Layout



X Validation Team Observer

I Instructor

① Table

② Student Seated

③ Kodak Carousel Slide Projector

④ HPI Telescreen "T", Model #6057 Rear projection screen

⑤ Wollensak Slide-Synch Audiovisual Cassette Playback Unit

⑥ Wollensak Monophonic Headphone, Model A-0483

⑦ Loaded Slide Tray and Audio Cassettes

Figure 41. Stage 3 Validation Trials Room Configuration

SUBSTEP 11-2. CONDUCT VALIDATION

Once planning of a validation is complete, the conduct of the trials is a relatively simple matter. The validation plan is followed unless unforeseen events make this impossible. For the small group trials, Stage 2, SDC was able to conduct the validation trials just as planned. For the group field test validation, Stage 3, the Air Force requested SDC to limit the materials to be validated to those for Block IV, Lessons 1-8, with which request SDC complied.

SUBSTEP 11-3. DETERMINE FINDINGS AND REVISIONS REQUIRED

The parts of the validation plan pertaining to validation measures, analysis planning and revision planning are to be followed in performing this substep. It may happen that an analysis not anticipated at the planning stage will suggest itself during the data analysis, and, if appropriate data are available, then such an analysis may be added during this substep provided enough funds and manpower are available to perform it.

A summary of SDC's analysis findings and revision decisions is presented below.

Stage One Findings

Informal notes taken by the course developers during intensive debriefings with those who played the role of students in the Stage 1 individual assessments at SDC provided the basis for revisions made prior to field tryouts. In general, the print and audio-visual presentation technique proved to be satisfactory during this internal review, though portions of the procedural instructions often require rewrite. No formal specifications or records were kept of the changes made.

Stage Two Findings

Four out of thirteen lessons had mean percent correct scores of less than 85%, making those lessons candidates for revision. About a third of the total number of enabling and criterion items were missed by at least one student, making those items and their associated instructional frames particular candidates for revision.

An analysis of the learning times for lesson elements versus times for the currently taught lessons shows that the mean time savings over all lessons was 40%, ranging from 34 to 70 percent per lesson and from 23 to 74 percent per student.

Analysis of the attitude survey data shows that results generally support the positive findings with respect to performance and learning time. The median rating over all attitude items and lessons was 7 on a 10-point rating scale in which 10 was high or positive. Highest ratings were for items pertaining to whether the material holds students' interest and to the utility of the tape/slide presentations.

Instructor critiques and the attitude data were used to guide the types of revisions made, as was the analysis of the incorrect answers for test items.

Figure 42 shows the revision percentages for each lesson for the Stage 2 validation.

Lesson Module	Programmed Instruction Frames	Enabling Test Items	Criterion Test Items	Audio Visual Slides
A	30	55	35	0
B	30	45	10	0
C	30	30	0	0
D	40	20	0	30
E	20	5	0	(N/A)
1	20	(N/A)*	60	(N/A)
2	80	30	35	10
3	70	5	15	35
4	35	35	0	30
5	45	35	25	5
6	50	40	10	5
7	55	25	35	(N/A)
8	75	0	25	(N/A)
Mean	45	25	20	15

*No Enabling Test for Lesson Module 1

(Note: Contents of table are estimates and have been rounded to nearest 5%.)

Figure 42. Lesson Module Revision Percentages (Stage 2)

Stage Three Findings

No Block IV lessons had mean percent correct scores of less than 85% in the large group field trials. In the Stage 2 trials, four of these lessons had mean percent correct scores of 70-84. SDC concludes that revisions made after the Stage 2 trials were effective in improving student performance. In analyzing errors on particular items from the Stage 3 trials, it was found that about a fourth of the total number of enabling and criterion items were missed by at least 15% of the students, making those items the focus of the Stage 3 revisions.

An analysis of learning times for the new Block IV lessons versus times for the currently used lessons shows a mean time savings over all Block IV lessons of 47%, with a range of 21 to 82 percent over lessons and a range of 34 to 52 percent among students.

Analysis of the Stage 3 attitude data show very favorable attitudes towards the self-paced materials. The lowest mean ratings were still well above the midpoints on the rating scales. Lesson 2 received the lowest mean rating (7) and lesson 8 the highest (9).

Figure 43 shows the estimated revision percentages for each lesson for the Stage 3 validation.

Lesson Module	Programmed Instruction Frames	Enabling Test Items	Criterion Test Items	Audio Visual Items
1	2	(N/A)*	0	(N/A)
2	5	2	0	0
3	11	0	4	0
4	8	0	2	0
5	2	0	0	0
6	24	3	20	0
7	7	0	6	(N/A)
8	0	1	0	(N/A)
Mean	7	1	4	0

*No Enabling Test for Lesson Module 1

(Note: contents are estimates and have been rounded to nearest 5%.)

Figure 43. Stage 3 Validation Lesson Revision Percentages

SUBSTEP 11-4. MAKE REVISIONS

Revisions to materials are made after each validation stage. SDC revised both instructional items and procedures after the Stage 1 validation. The revised materials were then used in the Stage 2 validation and revised materials resulting from the Stage 2 validation were used in the Stage 3 validation. This cyclical validation process will be continued by the Air Force after the materials are in use in the IM course.

The revision process itself is like that for the original preparation of the instructional materials, Step 9.

STEP 12. PREPARE COST ANALYSIS REPORT

A cost analysis is not always a mandatory step in the preparation of instructional materials. Its preparation is to be encouraged however, since valuable information that can be used in the future to improve instructional materials

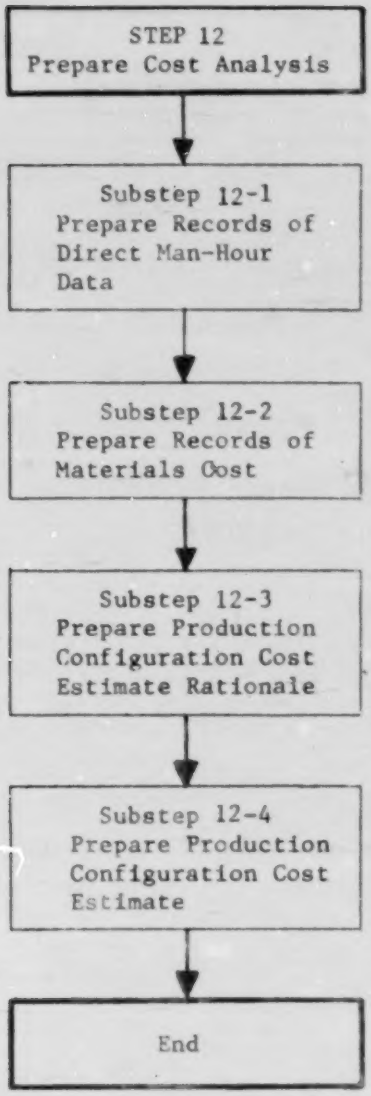


Figure 44. Substeps in Preparing Cost Analysis

development procedures is thereby preserved and made accessible. There is a certain amount of controversy at present about the amount of time that is required to develop effective programmed instructional materials. If all teams developing such materials would keep manpower times and material costs, much more accurate estimates would soon be available.

Figure 44 shows the substeps involved in preparing a cost analysis report of the sort requested by the Air Force for the IM course.

SUBSTEP 12-1. PREPARE RECORDS OF DIRECT MAN-HOUR DATA

As an instructional materials development project begins, forms should be developed to record man-hours expended. The form used by SDC for the IM course is shown in Figure 45.

Man-Hour Recording Form

	Direct Man Hours
Phase I	
Analysis of IM Course	104
Selection of Course Segments	37
Preparation of Technical Report	34
	175
Phase II	
Task Analysis	332
Development of Learning Objectives	417

Figure 45. Portion of Man-Hours Data Collection Form

SUBSTEP 12-2. PREPARE RECORDS OF MATERIALS AND RELATED COSTS

A form similar to the Man-Hour Recording form was used to record costs of materials, travel, duplication, and so forth. Figure 46 shows a portion of the form used for this purpose.

Materials and Related Costs Form

	Costs in Dollars
Phase IV	
Editorial support	729
Reproduction	2,874
TDY Travel	324
Black Slide Trays (180)	2,614
35 MM duplications of 545 (29 sets)	4,794
Visual arts support	340
Tape cassette duplication of 11 (29 sets)	1,058
	12,733

Figure 46. Portion of Materials and Related Costs Form

SUBSTEP 12-3. PREPARE ESTIMATE OF PRODUCTION CONFIGURATION COSTS RATIONALE

SDC was asked what materials development costs would be if instructional development work was performed in a production configuration. This estimate was to be based on the costs we incurred in a configuration that was assumed to be basically research and development oriented.

A rationale to account for the differences in costs in the two types of configurations is therefore required. SDC prepared two sets of assumptions for this substep to account for cost differences due to configuration. These sets of assumptions appear in Part Three, Phase IV of this report. The first set of assumptions applies to costs for a true R&D configuration versus a production configuration. The second set applies to costs in the SDC configuration, which was considerably more production-oriented than would be many research and development efforts, versus reproduction configuration. In a true R&D configuration, the methodology and strategies required to produce the instructional materials would have been developed especially for the IM project, adding considerably to direct man-hour costs. In SDC's configuration, methodologies and strategies for performing each phase of the work had already been developed for earlier projects and needed only to be adapted to the IM project. In a production configuration, existing methodologies are adapted to a number of different projects at the same time, so that personnel and materials are shared over a number of similar projects and the costs of special production equipment are shared also among a number of projects. Persons performing a specific task for an instructional development project tend to be quite specialized, in comparison to R&D project personnel, because the volume of work for that specific task is great. Therefore, specialists at different salary and skill levels, and with varying kinds of skills, can be utilized efficiently, lowering direct man-hour costs. For example, in an R&D configuration, one person might develop instructional strategies, perform task analyses, write instructional frames, and record audio material. In a production configuration, these tasks would be assigned to different people, at widely differing salary levels.

In a military setting, any of the three configurations described can be found, and each would be appropriate for a different set of conditions. The production configuration is, of course, to be preferred when conditions

make the applications possible. And, even then, an R&D unit is required to serve the production unit, so that advances in methodology, equipment, or theory can be made and applied to production.

Conditions that make a production configuration possible are as follows:

- Organization is large enough to allow great specialization among workers and a variety of equipment in-house.
- Volume of work is great enough that each specialist group can be kept busy full time.
- Instructional materials development methodologies, strategies, and techniques are efficient enough and versatile enough to be adapted to many different kinds of training needs.
- Advances in the state-of-the-art are infrequent enough that production personnel do not have to be retrained for each project or at short intervals.
- Well-trained personnel for each specialty are available to the organization.

As you may have guessed, there are few true production configurations in existence today. The state-of-the-art is constantly changing. Methodologies are constantly being improved, or at least changed. It is difficult to find well-trained programmed instruction frame writers -- indeed this task is still considered to be an art or a special talent by many persons working in the field. However, the military has a unique opportunity in the area of instructional materials development, due to its size, its enthusiasm for training or being trained, and its willingness to undertake large-scale research projects.

SUBSTEP 12-4. PREPARE PRODUCTION CONFIGURATION COST ESTIMATE

Cost figures and the production estimation rationales were used by SDC to prepare the cost analysis. This analysis is contained in Appendix E. It reports cost figures developed in substeps 12-1 and 12-2, lists

the estimation assumptions from substep 12-3, and contains estimates of the amount of reduction in costs that might be expected in a true production configuration. These reductions are relatively small due to the fact that SDC's configuration is production-oriented to a considerable degree. Figure 47 shows a portion of the summary of these estimates.

Other types of cost analyses might be useful in the military setting. For example, a cost-benefit analysis might provide useful information in which costs incurred in development of materials are evaluated with respect to improvements in trainee performance or to decrease in aptitude levels required to complete the course satisfactorily.

Potential Cost Reductions
In a Production Configuration

Phase III	% Reduction
Develop Instructional Materials	5%
Perform Pilot Study	5%
Develop Management Strategy	0%
Prepare Technical Report	20%

Figure 47. Part of the Summary of Potential Cost Reductions Estimated from SDC's Costs

REFERENCES

BIBLIOGRAPHY

Instructional Strategy

Air Force Military Personnel Testing System, AFM 35-8, Department of the Air Force, September 1962.

Cassileth, Barrie, Reinforcement Management: An Approach to Motivating Army Trainees, HumRRO Technical Report 69-17, November 1969.

Instructional System Development, ATC Reg. 52-33, Department of the Air Force, Headquarters Air Training Command, Randolph AFB, Texas.

Laberman, Davis D., Experience in Methods and Media Selection at the U.S. Army Southeastern Signal School, in CONARC Training Workshop Final Report, Vol. 5, Methods and Media Specialty Workshop, U.S. Continental Army Command, Fort Gordon, Ga., October 1971.

Sullivan, H. J., Baker, R. L., and Schutz, R. E. The Effects of Intrinsic and Reinforcement Contingencies on Learner Performance, USAF AMRL TR 66-138, Wright-Patterson AFB, Ohio; Aerospace Medical Research Laboratories, 1966.

Valverde, H. H., Maintenance Training Media: An Annotated Bibliography, USAF AMRL TR 67-151, May 1968.

Programmed Instruction

Brethower, Dale M., Programmed Instruction: A Manual of Programming Techniques, Chicago, Educational Methods, 1963.

Mager, Robert F., Preparing Objectives for Programmed Instruction, San Francisco, Fearon, 1962.

Markle, Susan Meyer, Good Frames and Bad, New York, John Wiley and Sons, 1964.

APPENDIX A

CENTRAL FILE LISTING

INVENTORY MANAGEMENT SPECIALIST CENTRAL FILE LISTING

FILE #	DOCUMENT CONTROL #	SUBJECT
001	64530-1	PLAN OF INSTRUCTION - Inventory Management Specialist
002	STS 645XO	Inventory Management Specialist and Inventory Management Supervisor, 7 November 1969
003	TDLO-1	Lesson Plan - Orientation
004	64530-1-I-2	Lesson Plan - Airman Supply Career Field
005	64530-1-I-3	Lesson Plan - Communications Security
006	64530-1-I-4	Lesson Plan - USAF Supply System
007	64530-1-I-5	Lesson Plan - Air Force Stock Fund
008	64530-1-I-6	Lesson Plan - USAF Supply Manual
009	64530-1-I-7	Lesson Plan - Master Cross Reference List
010	64530-1-I-8	Lesson Plan - Illustrated Parts Breakdown
011	64530-1-I-9	Lesson Plan - Cataloging Handbooks
012	64530-1-I-10	Lesson Plan - USAF Federal Supply Catalogs
013	64530-1-I-11	Lesson Plan - USAF Interchangeable and Substitute Grouping Stock List
014	64530-1-I-12	Lesson Plan - Index of Cataloging Publications
015	64530-1-I-13	Lesson Plan - Research Functions
016	64530-1-II-1	Lesson Plan - Standard Base Supply System
017	64530-1-II-2	Lesson Plan - Internal and External Records
018	64530-1-II-3	Lesson Plan - File Maintenance Procedures
019	64530-1-II-4	Lesson Plan - Remote Operations
020	64530-1-II-5	Lesson Plan - Supplies Issue Procedures
021	64530-1-II-6	Lesson Plan - Repair Cycle and DIFM Control
022	64530-1-II-7	Lesson Plan - Rejects and Inquiries
023	64530-1-II-8	Lesson Plan - Bench Stock Operations
024	64530-1-II-9	Lesson Plan - Supplies Inventory
025	64530-1-II-10	Lesson Plan - Item Accounting & Maintenance Support Functions
026	64530-1-III-1	Lesson Plan - Stock Control Levels

FILE #	DOCUMENT CONTROL #	SUBJECT
027	64530-1-III-2	Lesson Plan - Initial Spares Support Lists
028	64530-1-III-3	Lesson Plan - MILSTRIP Requisitions
029	64530-1-III-4	Lesson Plan - MILSTRIP Related Products
030	64530-1-III-5	Lesson Plan - Base Procurement
031	64530-1-III-6	Lesson Plan - Due-Out Revalidation and Due-In Reconciliation
032	64530-1-III-7	Lesson Plan - Materiel Control
033	64530-1-III-8	Lesson Plan - Monitoring Priority Requirements
034	64530-1-III-9	Lesson Plan - Receipts & Due-Out Releases
035	64530-1-III-10	Lesson Plan - Stock Balance & Consumption Reports
036	64530-1-III-11	Lesson Plan - Base Excesses
037	64530-1-III-12	Lesson Plan - Shipments & Transfers
038	64530-1-III-13	Lesson Plan - Document Control
039	64530-1-III-14	Lesson Plan - Stock Control Functions
040	64530-1-III-15	Lesson Plan - Manual Accounting Systems
041	64530-1-IV-1	Lesson Plan - Air Force Equipment Management System
042	64530-1-IV-2	Lesson Plan - Allowance Documents
043	64530-1-IV-3	Lesson Plan - Authorization Procedures
044	64530-1-IV-4	Lesson Plan - EAID Records
045	64530-1-IV-5	Lesson Plan - Equipment Issue Procedures
046	64530-1-IV-6	Lesson Plan - Equipment Turn-In Procedures
047	64530-1-IV-7	Lesson Plan - Adjusting EAID Records
048	64530-1-IV-8	Lesson Plan - Inter-Custody Transfers
049	64530-1-IV-9	Lesson Plan - REM Procedures
050	64530-1-IV-10	Lesson Plan - Reports and Special Procedures
051	64530-1-IV-11	Lesson Plan - Equipment Inventories
052	64530-1-IV-12	Lesson Plan - Individual Equipment & Tool Issue Procedures
053	64530-1-IV-13	Lesson Plan - Equipment Management Functions
054	64530-1-I-2(N)	Study Guide/Workbook - Airman Supply Career Field
055	64530-1-I-3(N)	Study Guide/Workbook - Communications Security
056	64530-1-I-4(N)	Study Guide/Workbook - USAF Supply System

FILE #	DOCUMENT CONTROL #	SUBJECT
057	64530-1-I-5(N)	Study Guide/Workbook - Air Force Stock Fund
058	64530-1-I-6(N)	Study Guide/Workbook - USAF Supply Manual
059	64530-1-I-7(N)	Study Guide/Workbook - USAF Master Cross Reference List
060	64530-1-I-8(N)	Study Guide/Workbook - Illustrated Parts Breakdown
061	64530-1-I-9(N)	Study Guide/Workbook - Cataloging Handbooks
062	64530-1-I-10(N)	Study Guide/Workbook - USAF Federal Supply Catalogs
063	64530-1-I-11(X)	Workbook - USAF Interchangeable & Substitute Grouping Stock Lists
064	64530-1-I-11(X)	Programmed Text - USAF Interchangeable & Substitute Grouping Stock Lists
065	64530-1-I-12(N)	Study Guide/Workbook - Index of Cataloging Publications
066	64530-1-II-1	Study Guide/Workbook - Standard Base Supply System
067	64530-1-II-2	Study Guide/Workbook - Internal and External Records
068	64530-1-II-3	Study Guide/Workbook - File Maintenance Procedures
069	64530-1-II-4	Study Guide/Workbook - Remote Operations
070	64530-1-II-5	Workbook - Supplies Issue Procedures
071	64530-1-II-5	Programmed Text - Supplies Issue Procedures
072	64530-1-II-6	Study Guide/Workbook - Repair Cycle and DIFM Control
073	64530-1-II-7	Study Guide/Workbook - Rejects and Inquiries
074	64530-1-II-8	Study Guide/Workbook - Bench Stock Operations
075	64530-1-II-9	Workbook - Supplies Inventory
076	64530-1-II-9	Programmed Text - Supplies Inventory
077	64530-1-III-1(N)	Study Guide - Stock Control Levels
078	64530-1-III-1A	Workbook - Stock Control Levels
079	64530-1-III-1B	Workbook - Stock Control Levels
080	64530-1-III-2(N)	Study Guide/Workbook - Initial Spares Support Lists
081	64530-1-III-3(N)	Study Guide/Workbook - MILSTRIP Requisitions
082	64530-1-III-4(N)	Study Guide/Workbook - MILSTRIP Related Products
083	64530-1-III-5(N)	Study Guide/Workbook - Inventory Management Specialist Course
084	64530-1-III-6(N)	Study Guide/Workbook - Due-Out Revalidation and Due-In Reconciliation
085	64530-1-III-7(N)	Study Guide/Workbook - Materiel Control

FILE #	DOCUMENT CONTROL #	SUBJECT
086	64530-1-III-8(N)	Study Guide/Workbook - Monitoring Priority Requirements
087	64530-1-III-9(N)	Study Guide/Workbook - Receipts and Due-Out Releases
088	64530-1-III-10(N)	Study Guide/Workbook - Stock Balance and Consumption Reports
089	64530-1-III-11(N)	Study Guide/Workbook - Base Excesses
090	64530-1-III-12(N)	Study Guide/Workbook - Shipments & Transfers
091	64530-1-III-13(N)	Study Guide/Workbook - Document Control
092	64530-1-III-14(N)	Workbook - Stock Control Functions
093	64530-1-III-16(X)	Study Guide - Manual Accounting System
094	64530-1-IV-1(N)	Study Guide/Workbook
095	64530-1-IV-2(N)	Study Guide/Workbook - Allowance Documents
096	64530-1-IV-3(N)	Study Guide/Workbook - Authorization Procedures
097	64530-1-IV-4(N)	Study Guide/Workbook - EAID Records
098	64530-1-IV-5(N)	Study Guide/Workbook - Equipment Issue Procedures
099	64530-1-IV-6(N)	Study Guide/Workbook - Equipment Turn-In Procedures
100	64530-1-IV-7(N)	Study Guide/Workbook - Adjusting EAID Records
101	64530-1-IV-8(N)	Study Guide/Workbook - Intercustody Transfers
102	64530-1-IV-9(N)	Study Guide/Workbook - REM Procedures
103	64530-1-IV-10(X)	Workbook - Reports and Special Procedures
104	64530-1-IV-10(E)	Programmed Text - Reports and Special Procedures
105	64530-1-IV-11(N)	Study Guide/Workbook - Equipment Inventories
106	64530-1-IV-12(X)	Workbook - Individual Equipment and Tool Issue Procedures
107	64530-1-IV-12(X)	Programmed Text - Individual Equipment and Tool Issue Procedures
108	64530-1-IV-13(N)	Workbook - Equipment Management Functions
109	HO TSLS-2	Federal Supply Catalog - Master Cross Reference List
110	HO TSLS-3	Master Index
110A	TSLS-4	AFM 67-1 Volume I - Part One
111	HO TSLS-5	AFM 67-1 Volume II - Part Two
112	64530-1-I-GEN-1(N)	Handout - General and Research
112A	64530-1-I	Handout TDLO-1 Orientation
113	64530-1-I-2(X)	Handout - Airman Supply Career Field
114	64530-1-I-3(X)	Handout - Communications Security

FILE #	DOCUMENT CONTROL #	SUBJECT
115	64530-1-I-4(X)	Handout - USAF Supply System
116	64530-1-I-5(X)	Handout - Air Force Stock Fund
117	64530-1-I-6(X)	Handout - USAF Supply Manual
118	64530-1-I-7(X)	Handout - USAF Master Cross Reference List
119	64530-1-I-8(X)	Handout - Illustrated Parts Breakdown
119A	64530-1-I-8	Handout - General Airplane (T.O. IT-38A-4-1)
120	64530-1-I-9(X)	Handout - Cataloging Handbooks
121	64530-1-I-9-1	Handout - Cataloging Handbook (H2-1), Part 1, Groups and Classes
122	64530-1-I-9-2	Handout - Cataloging Handbook (H2-3), Part 3, Alphabetic Index
123	64530-1-I-10(X)	Handout - USAF Federal Supply Catalogs
124	64530-1-I-10-1	Handout - Federal Supply Catalog, Identification List (FSC 1610)
125	64530-1-I-10-2	Handout - Introduction to Federal Supply Catalog (C-1-AF)
126	64530-1-I-11-1	Handout - USAF Interchangeability and Substitution Grouping Stock List
127	64530-1-I-11-2	Handout - USAF Stock List and Related Publications System (S-1)
128	64530-1-I-12-1	Handout - Index of USAF and DOD Federal Supply Catalogs and Related Cataloging Publications USAF S-2A-1
129	64530-1-I-12(X)	Handout - Index of Cataloging Publications
130	64530-1-I-13(N)	Workbook - Research Functions
131	64530-1-I-13-A&B(X)	Handout - Research Problems
132	64530-1-II-1	Handout - Standard Base Supply System
132A	64530-GEN-II(N)	Handout - Codes, Data Elements, and Formats
133	64530-1-II-2	Handout - Internal and External Records
134	64530-1-II-3	Handout - File Maintenance Procedures
135	64530-1-II-4	Handout - Remote Operations
136	64530-1-II-6	Handout - Repair Cycle and DIFM Control
137	64530-1-II-7	Handout - Rejects and Inquiries
138	64530-1-II-8	Handout - Bench Stock Operations
139	64530-1-II-10	Handout - Item Accounting and Maintenance Support Functions

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FILE #	DOCUMENT CONTROL #	SUBJECT
140	64530-1-GEN-II(N)	Handout - Codes, Data Elements, and Formats
141	64530-1-GEN-III(N)	Handout - Codes, Data Elements, and Formats
142	64530-1-III-2(X)	Handout - Initial Spares Support Lists
143	64530-1-III-3(X)	Handout - MILSTRIP Requisitions
144	64530-1-III-4(X)	Handout - MILSTRIP Related Products
145	64530-1-III-5(X)	Handout - Base Procurement
146	64530-1-III-6(X)	Handout - Due-Out Revalidation and Due-In Reconciliation
147	64530-1-III-7(X)	Handout - Materiel Control
148	64530-1-III-8(X)	Handout - Monitoring Priority Requirements
149	64530-1-III-9(X)	Handout - Receipts and Due-Out Releases
150	64530-1-III-10(X)	Handout - Stock Balance and Consumption Reports
151	64530-1-III-11(X)	Handout - Base Excesses
152	64530-1-III-12(X)	Handout - Shipments and Transfers
153	64530-1-III-13(X)	Handout - Document Control
154	64530-1-III-14(X)	Handout - Stock Control Functions
155	64530-1-GEN-IV(N)	Handout - Codes, Data Elements, and Formats
156	64530-1-IV-1(X)	Handout - Air Force Equipment Management
157	64530-1-IV-2(X)	Handout - Allowance Documents
158	64530-1-IV-2-1	Handout - AFR 0-10 - Index of Allowance Source Codes and Organization Tables
159	64530-1-IV-2-2	Handout - TA006 - Organizational and Administrative Equipment
160	64530-1-IV-2-3	Handout - TA016 - Table of Allowance for Personal and Special Purpose Clothing and Equipment USAF
161	64530-1-IV-3(X)	Handout - Authorization Procedures
162	64530-1-IV-4(X)	Handout - EAID Records
163	64530-1-IV-5(X)	Handout - Equipment Issue Procedures
164	64530-1-IV-6(X)	Handout - Equipment Turn-in Procedures
165	64530-1-IV-7(X)	Handout - Adjusting EAID Records
166	64530-1-IV-8(X)	Handout - Intercustody Transfers
167	64530-1-IV-9(X)	Handout - REM Procedures
168	64530-1-IV-11(X)	Handout - Equipment Inventories
169	64530-1-IV-13(X)	Handout - Equipment Management Functions

FILE #	DOCUMENT CONTROL #	SUBJECT
170	64530-1-I-13	Chart Summary of Publications used in Block I
171	64530-1-II-3	Handout - Problem 12
172	64530-1-II-5	Handout - Problem 1 and Problem 2
173	64530-1-II-5	Script - Supply Issue Procedures
174	64530-1-II-5	Problem 1, Problem 2, and Problem 3
175	64530-1-II-6	Handout - Problem 9 DIFM Listing
176	64530-1-II-7	Handout - Problem 3, Problem 4, Problem 5, Problem 6
177	64530-1-II-8	Handout - Problems 10, 11, 12, 13 and 14
178	64530-1-II-10	Handout - Problems 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36
179	64530-1-III-5	Handout - Problems 12, 13, 14, 15
180	64530-1-III-7	Handout - Problems 4 and 5
181	64530-1-III-8	Handout - Problems 4 and 5
182	64530-1-III-12	Handout - Problems 7, 8 and 9
183	64530-1-III-14	Handout - Problems 23 thru 37
184	64530-1-IV-10	Handout - Register of Control Numbers - Problems 1 and 2
185	64530-1-IV-12	Handout - Problems 1 thru 12
186	64530-1-IV-13	Handout - Individual Evaluation Project - Problems 22-37
187	RFQF33615-71-Q-2181	Development of a Prototype of an Individual Instructional System (Inventory Management Specialist Course)
188		Occupational Survey Report for the IM Specialist
189	64530-I	Written and Performance Test (A-F)
190	64530-II	Written and Performance Test (A-F)
191	64530-III	Written and Performance Test (A-F)
192	64530-IV	Written and Performance Test (A-F)
193	AFM 67-1	Vol. I, Part One, Chapters 2, 10, 12
194	AFM 67-1	Vol. I, Part Four, Chapters 3, 12
195	AFM 67-1	Vol. II, Part One, Chapters 1,3,4,6,7,8,9,11,14,16,17
196	AFM 67-1	Vol. II, Part Two, Chapters 1 thru 23
196a	AFM 67-1	Vol. II, Part Two, Amendments 7,8,9
196b	AFM 67-1	Vol. II, Part Two, Amendments 11, 12
197	AFM 67-1	Vol. IV, Part One, Chapters 5,6,7,8,9,10,19,21,22

FILE #	DOCUMENT CONTROL #	SUBJECT
198	CDC 64533	Inventory Management Specialist, Volumes 2, 4, 5
199	CDC 64533	Workbook, Volumes 1, 2, 3, 4
200	CDC 64533	Handout (TSLS-4) AFM, Vol. I - Part One
201		Block I Transparencies 117-123 (Missing)
202		Block II Transparencies 222, 224, 225, 226, 227, 231-234
203		Block III Transparencies 315
204		Block IV Transparencies 40-1434
205	AMRL-TR-6851	LEARNER-CENTERED INSTRUCTION (LCI): Volume II -- Job Behavioral Description for AFSC 322X1R, August 1968
206	AFSC 645X0/647X0	UNITED STATES AIR FORCE JOB INVENTORY, Inventory Management and Materiel Facilities Career Ladders, 15 July 1971

APPENDIX B

METHODS AND MEDIA SELECTION MATRIX

APPENDIX B

METHODS AND MEDIA SELECTION MATRIX

INSTRUCTIONAL STRATEGY 1 - YES 0 - NO																	
Self-paced?	Background?	Instructor?	Response?	S Reads?	METHODS I	II	III	IV	V	VI	MEDIA A	B	C	D	E	F
0	0	0	0	0	L	D	D	L	D	D	A	A w/AO&SV	A w/SV	A w/MV	A w/AO&SV	A w/MV
0	0	0	0	1	SA	D	D	SA	D	D	P	P w/AO&SV	P w/SV	P w/MV	P w/AO&SV	P w/MV
0	0	0	1	0	CPE	CPE	CPE	CPE	CPE	CPE	A	A w/AO&SV	A w/SV	A w/MV	A w/AO&SV	A w/AO&MV
0	0	0	1	1	(PI)	(PI)	CPE	(PI)	CPE	(PI)	P	P w/AO&SV	P w/SV	P w/MV	P w/AO&SV	P w/AO&MV
0	0	1	0	0	L	D	D	L	D	D	I	I w/AO	I w/SV	I w/AO	I w/AO	I w/AO
0	0	1	0	1	L	D	D	L	D	D	I w/P	I w/AO&P	I w/SV&P	I w/AO&P	I w/AO&P	I w/AO&P
0	0	1	1	0	IC	C,D	CPE	IC	CPE	IC,D	I	I w/AO	I w/SV	I w/AO	I w/AO	I w/AO
0	0	1	1	1	IC	C,D	CPE	IC	CPE	CPE	I w/P	I w/AO&P	I w/SV&P	I w/AO&P	I w/AO&P	I w/AO&P
0	1	0	0	0	L	L	L	L	L	L	A	A w/SV	A	A w/SV	A w/SV	A w/SV
0	1	0	0	1	SA	SA	SA	SA	SA	SA	P	P w/SV	P	P w/SV	P w/SV	P w/SV
0	1	0	1	0	PE	PE	C&P	PE	C&P	CS	A	A w/SV	A	A w/SV	A w/AO	A w/SV
0	1	0	1	1	(PI)	(PI)	PE,TP	CS	TP	CS	P	P w/SV	P	P w/SV	P w/AO	P w/SV
0	1	1	0	0	L	L	L	L	D	L	I	I w/SV	I	I w/SV	I w/SV	I w/AO
0	1	1	0	1	L	L	L	L	D	L	I w/P	I w/SV&P	I w/P	I w/SV&P	I w/SV&P	I w/AO&P
0	1	1	1	0	DC	DC	CPE	DC	CPE	DC	I	I w/SV	I	I w/SV	I w/AO	I w/AO
0	1	1	1	1	DC	DC	CPE	IP	CPE	RP	I w/P	I w/SV&P	I w/P	I w/SV&P	I w/AO&P	I w/AO&P
1	0	0	0	0	L	D	D	L	D	D	A	A w/AO&SV	A w/SV	A w/MV	A w/AO&SV	A w/MV
1	0	0	0	1	SA	D	SA	SA	D	D	P	P w/AO&SV	P w/SV	P w/MV	P w/AO&SV	P w/MV
1	0	0	1	0	IPE	IPE	PI	IPE	PI	PI	A	A w/AO&SV	A w/SV	A w/MV	A w/AO&SV	A w/AO&MV
1	0	0	1	1	(PI)	(PI)	(PE)	(PI)	(PE)	PI(IE)	P	P w/AO&SV	P w/SV	P w/MV	P w/AO&SV	P w/AO&MV
1	0	1	0	0	L	D	D	L	D	D	I	I w/AO	I w/SV	I w/AO	I w/AO	I w/AO
1	0	1	0	1	L	D	D	L	D	D	I w/P	I w/AO&P	I w/SV&P	I w/AO&P	I w/AO&P	I w/AO&P
1	0	1	1	0	T	T	T	T	T	T	I	I w/AO	I w/SV	I w/AO	I w/AO	I w/AO
1	0	1	1	1	T	T	T	T	T	IP	I w/P	I w/AO&P	I w/SV&P	I w/AO&P	I w/AO&P	I w/AO&P
1	1	0	0	0	L	L	L	L	L	L	A	A w/SV	A	A w/SV	A w/SV	A w/SV
1	1	0	0	1	SA	SA	SA	SA	SA	SA	P	P w/SV	P	P w/SV	P w/SV	P w/SV
1	1	0	1	0	IPE	IPE	IPE	PI	IPE	PI	A	A w/SV	A	A w/SV	A w/AO	A w/AO
1	1	0	1	1	(PI)	(PI)	IPE	IP&IE	IPE	PI	P	P w/SV	P	P w/SV	P w/AO	P w/AO
1	1	1	0	0	L	L	L	L	L	L	I	I w/SV	I	I w/SV	I w/SV	I w/SV
1	1	1	0	1	L	L	L	L	L	L	I w/P	I w/SV&P	I w/P	I w/SV&P	I w/SV&P	I w/SV&P
1	1	1	1	0	T	T	T	T	T	T	I	I w/SV	I	I w/AO	I w/AO	I w/AO
1	1	1	1	1	T	T	T	IP	T	T	I w/P	I w/SV&P	I w/P	I w/AO&P	I w/AO&P	I w/AO&P

C&P COACH AND PUPIL
CPE CONTROLLED PRACTICAL EXERCISE
CS CASE STUDY
D DEMONSTRATION
DC DEVELOPMENTAL CONFERENCE
IC INSTRUCTIONAL CONFERENCE
IE IN-BASKET EXERCISE
IP INCIDENT PROCESS
IPE INDEPENDENT PRACTICAL EXERCISE
L LECTURE
PI PROGRAMMED INSTRUCTION
RP ROLE PLAYING
SA STUDY ASSIGNMENT
T TUTORIAL
TP TEAM PRACTICE
( ) EITHER OR BOTH

A AUDIO
AO ACTUAL OBJECT
I INSTRUCTOR
MV MOTION VISUAL
P PRINT
SV STILL VISUAL
W WITH

APPENDIX C

MANAGEMENT PLAN

DESCRIPTION OF CHANGES REQUIRED FOR THE SELECTION MANAGEMENT FUNCTIONS

A plan for each new function or function for which changes are required due to the effect of IM course individualization is offered in this section. For the sake of clarity, functions that must be performed, but for which no changes are required, are listed with the notation No Changes Required.

Collect Student Background and Characteristics Data

No changes required.

Estimate Student Course Completion Date

The purpose of estimating of each student's completion date is three-fold: to aid in student incentive management; to aid in predicting effective allocation of instructional resources; and to assist in scheduling students for assignment to non-individualized portions of the course and for job assignment after course completion.

The initial estimate of completion dates will be based on student background data, such as AFQT score, AQE score for A and G, and student experience in the career ladder prior to the course. Until more empirical data are collected on the rates of student progress, it is difficult to provide an adequate algorithm for estimation of completion dates. It is suggested that the time values shown in Table C-1 be assigned for use until actual data are available. Validation studies completed show generally greater time savings than those shown in Table C-1.

Table C-1. Initial Estimates of Course Completion Dates

Student Background and Characteristics Category	Estimated Time to Complete Individualized Portions of the Course
AFQT Category 1 or 2; AQE A and/or G 70 up; has been a Supply Helper or Apprentice Specialist prior to course.	50% of current course time.
AFQT Category 1 or 2; AQE A and/or G 60-69; has been a Supply Helper or Apprentice Specialist prior to course.	55% of current course time.
AFQT Category 1 or 2; AQE A and/or G 60 up; has not been a Supply Helper or Apprentice Specialist.	60% of current course time.
AFQT Category 3; AQE A and/or G 60 up; has not been a Supply Helper or Apprentice Specialist.	65% of current course time.
AFQT Category 3; AQE A and/or G 60 up; has not been a Supply Helper or Apprentice Specialist	70% of current course time.
AFQT Category 1-4, AQE A and/or G 50-60; has been a Supply Helper or Apprentice Specialist	75% of current course time.
AFQT Category 1-4, AQE A and/or G 50-60; has not been a Supply Helper or Apprentice Specialist.	80% of current course time.
AFQT Category 1-4; AQE less than 50.	90% of current course time.

These initial completion estimates should become a part of the initial Student Planning Report and thus should be supplied by the administrative staff to instructors. An instructor can then discuss this date with the student and explain the process whereby the date will be revised to correspond with student progress.

Prepare Reports for Student Planning and Scheduling

Because individualized portions of the IM course will be self-paced, instructors will need aids for organizing and structuring their planning activities. A report form in which the progress of an individual student can be summarized will enable the instructor to evaluate the student's progress and to counsel him more effectively. Figure C-1 shows a report form that is useful in planning and for analysis within individualized instructional systems. Ideally, the Student Report would be updated daily.

ALLOCATE AND SCHEDULE RESOURCES AND STUDENTS

Instructional resources (facilities, equipment, materials, instructors, etc.) must be initially allocated by the administrative staff and then scheduled on a daily basis by course instructors. Individualization of the course increases allocation and scheduling problems somewhat, compared to the traditional instructional activities as a group. The fact that only a portion of the course is individualized could increase scheduling problems also, particularly the scheduling of students.

Several routes through the IM course may be feasible, but the simplest and easiest to schedule would be to group-pace the lesson modules in Blocks I-III and reserve self-pacing for Block IV.

STUDENT REPORT FORM

Name _____

SSN _____ AQE A _____ G _____

Class _____ AFQT _____

Start Date _____ Completion Date _____ Pre-Course Experience _____

Estimated completion dates for Lesson Modules 1-8:

1	2	3	4	5	6	7	8

Module Entry/Completion Data and Criterion Task Scores:

① Enter date and time

② Enter S (Satisfactory) or U (Unsatisfactory)

	Date	Time
Module 1 begun:	_____	_____ ①
Module 1 comp.:	_____	_____
Task 1:	_____	_____ ②
Task 2:	_____	_____
Task 3:	_____	_____
Task 4:	_____	_____
Module 2 begun:	_____	_____
Module 2 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____
Module 3 begun:	_____	_____
Module 3 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____
Module 4 begun:	_____	_____
Module 4 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____

	Date	Time
Module 5 begun:	_____	_____
Module 5 comp.:	_____	_____
Task 1:	_____	_____
Module 6 begun:	_____	_____
Module 6 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____
Task 3:	_____	_____
Task 4:	_____	_____
Module 7 begun:	_____	_____
Module 7 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____
Task 3:	_____	_____
Task 4:	_____	_____
Module 8 begun:	_____	_____
Module 8 comp.:	_____	_____
Task 1:	_____	_____
Task 2:	_____	_____
Task 3:	_____	_____

Progress Summary:

Figure C-1. Student Report Form

The major disadvantage is that for the first 30 hours that have been individualized, the benefits of self-pacing are lost. Students complete an individual self-paced module and then return to group-paced instruction. Students who finish before the time allotted for the individualized instruction is up will not be a problem particularly, since they can be dismissed for the day or can assist instructors as tutors and demonstrators. Exceptionally slow students will be somewhat more of a problem in that they may not be able to finish in the allotted time. A solution to this problem -- washback, extra time, remedial instruction or another action -- will be best arrived at as a policy decision of school administrators, taking into account the fact that practice over several hours is not usually an effective way to produce learning, particularly in slow students.

A possible alternative to group-pacing the first three blocks of instruction would be to take the individualized lessons out of their current sequence among group-paced lessons and group them all together. Subject matter experts would have to be consulted to identify any learning problems likely to be caused by altering the normal sequence of course content.

Assuming that Block IV will be individualized and self-paced, to avoid scheduling problems it will be most satisfactory to utilize several of the instructors to work within this last portion only, as is the practice in the current course. This set of instructors can accept new Block IV students each week to replace students who have completed the previous course modules. Each instructor will be responsible for one or two lesson modules only. This allocation method allows the school to keep the instructor-student ratio balanced more efficiently than would be possible if one instructor stayed with a particular group of students until the last one finished the course.

Table C-2 shows the planned student locations within Block IV and gives requirements for numbers of instructors, carrels, and sets of audiovisual materials, rooms, and sets of programmed instructional materials.

Table C-2. IM Course Resource Requirements for Block IV

	Room	Carrels and Materials	Instructors	PI Materials
Lessons 1 & 2	#1	None	2	20 sets ea. lesson
Lessons 3 & 4	#3	None	2	20 sets ea. lesson
Lessons 5-8	#4	None	2	20 sets ea. lesson
	#2	25	1	
Totals	4	25	7	20 sets ea. lesson

Because so many students will be requiring audiovisual equipment at the beginning of lesson 2, before self-pacing has spread students among the lessons, it was decided to locate all carrels in a room separate from that to be used for studying the PI materials.

Figure C-2 shows planned student flow within Block IV. The student enters classroom #1. He obtains the necessary materials for that lesson. He begins studying his PI text until the lesson materials direct him to an audiovisual carrel. He then goes to room #2. If all the carrels are occupied, he either waits for one to become available or he takes a short break. Upon concluding his interaction with the carrel, he returns to his original seat in room #1. This type of interaction may be continued until lesson terminus. Upon concluding the lesson, the criterion test is turned in to the instructor for scoring. If deficiencies are noted, a remedial prescription is generated by the instructor and remediation is carried out in classroom #2. When the student has successfully completed a lesson, he turns in his materials and either 1) stays in the same room and obtains new lesson materials, or 2) moves to the room for lessons 3 and 4.

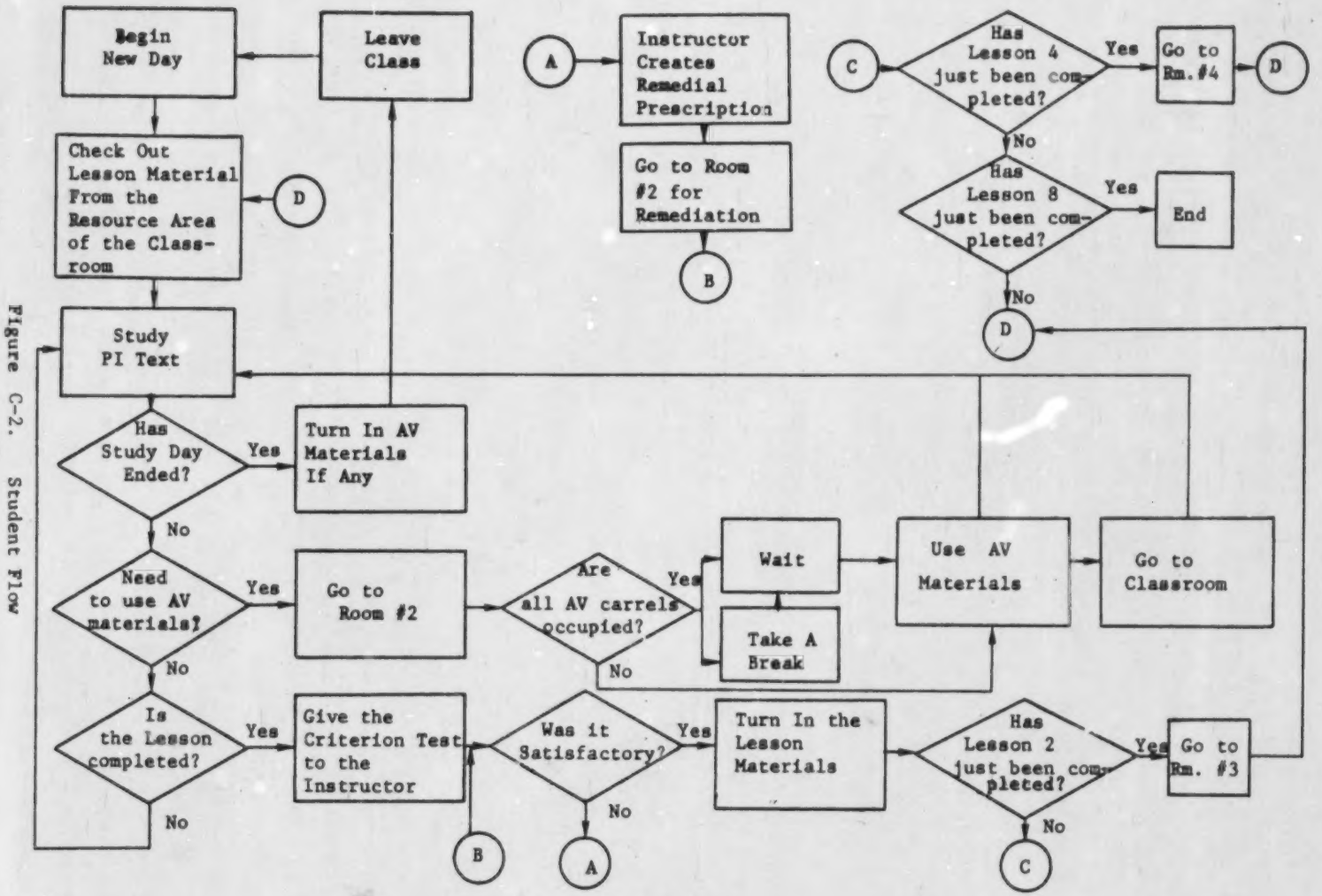

Figure C-2. Student Flow

Learning time data collected during validation trials has been used to estimate the times required for carrel use and to complete lessons within Block I. Table C-3 presents this information, in hours and minutes.

Table C-3. Estimates of Learning Times

Lessons	Carrel Time	Estimated Median Lesson Time
1	- -	2:15
2	0:38	7:45
3	0:17	4:15
4	0:17	3:30
5	0:36	3:30
6	0:22	3:15
7	- -	2:00
8	- -	1:00
	1:30	27:30

Daily Scheduling Log

A daily student log will be required for each Block IV student for allocation and scheduling on a daily basis. Figure C-3 presents a sample log. The log will aid the instructors in ascertaining which resources will be used the next day, how a student is progressing, and where a student is at any given time. The log should be designed and located so that the students themselves can ordinarily enter the required information.

The instructors can review the log at the end of the day as a planning aid, reserve media and materials, and can prepare for tutorial help or demonstrations required for the next day. The log book might be kept in the room in which the carrels are, Room 2.

Having the student fill out the log himself plays a part in incentive management, aiding in making the student feel responsible for his rate of progress. An instructor will need to monitor this activity rather closely at first to ensure that students do not set unrealistic or irresponsible goals for themselves. Until empirical data on student rates of progressions are available, instructors should not push students unduly to finish quickly. Validation studies completed show that the maximum time required to finish Block IV should be less than a week.

- Name _____
- ID Number _____
- Expected course completion date _____
- Lesson modules completed, including criterion tests passed _____

Day 1:

- Location now _____
- Expected completion date/time of current module _____
- Expected need (next say) for:
    - tape/slide equipment _____
    - tape and slide sets (which) _____
    - new lesson module (which) _____
    - test monitoring and scoring _____
    - practical exercises or demonstration (which) _____

Day 2:

- Location now _____

Figure C-3. Portions of a Daily Scheduling Log

Student/Instructor Roster

The allocation and scheduling plan described in this plan will require a change to procedures for preparing a student/instructor roster, since a given student will not have the same instructor for a specific number of days.

Instructor/Student Load Balance

Student load during the group-paced portion of the IM course can be handled much as it is currently. There should be very little problem with student distribution in Block IV classrooms because the projected median time for completion of Block IV is 27 hours 30 minutes -- less than a week. Therefore, no new students will be entering that block, since new students enter on a weekly basis, while the previous group is still present. Thus, the maximum number of students assigned to any given instructor would be 20, a load well within the instructor's capabilities to handle.

Schedule Students for Job Assignment

Because all students who enter the IM course in a given week will not be finishing on the same day, a procedure for scheduling students for early job assignment might be devised. A policy decision is required as to whether students who finish early will be given leave, kept at the school (if the time period is short), or scheduled for job assignment early. Early assignment could mean a change in job location, the disadvantages of which must be considered. SDC feels that the solution to this problem is outside the scope of a technical plan. The problem will not be particularly severe for the IM course, because the self-paced (final) block of instruction will be only a week along, which does not make it possible for a student fo finish the course more than a few days early. However, the IM course affords the opportunity to try several solutions in a test bed environment to aid in selecting the best solution for the entire AIS at a later time. A change to personnel management policies with respect to job assignments is probably indicated for courses that are entirely self-paced. Recommendations in this area are outside the scope of this Plan, but will require formulation for the operational AIS.

Conduct Learning Sessions, Present Materials, Equipment

Individualization changes the instructor's role in the classroom. Instructors will require assistance in learning to perform this new role. The Instructor's Guides created along with the instructional materials are intended to provide this assistance. SDC personnel will also brief the instructors on the materials and on the instructor role. It is not thought that additional written assistance will be required. However, instructors should organize a workshop to familiarize themselves with the new materials and with their new roles. A suggested agenda is shown below.

- The role of the instructor in an individualized instructional system
- Student response to individualized instruction
- Student motivation and incentive management
- The new IM materials
- The Instructor Guides
- IM course organization and student flow
- New procedures for instructors
- The Student Report
- The Scheduling Log
- Scheduling and allocation of resources for the IM course
- Administrative and evaluative activities
- Dry run of instructional activities
- Debriefing critique

It is recommended that SDC personnel responsible for materials validation attend the workshop and participate in its development.

Monitor Student Progress

The Instructor's Guide also serves as an aid in monitoring student progress, as do the Scheduling Log and the Student Reports for planning.

Furnish Tutorial Aid, Counselling Revised Plans and Schedules

When students require tutorial aid, the instructor can provide this himself or select a capable student to provide the aid. A policy decision is required as to the extent to which the capable student is to be utilized in this activity. An important consideration is the following: if students who finish early are to be rewarded by being given leave or passes, they may perceive tutoring as a punishment. In addition, if a particular student sets high goals for himself and is diverted from finishing by his initially estimated completion date, he may also perceive this as punishment. A lack of motivation, with respect to both course work and training, could be the result. On the other hand, capable students can function very effectively as tutors. It may be that, if policy decisions favor use of students as tutors and reject the concept of early job assignment, a lack of emphasis on early completion dates would be desirable. In this case, the earliest estimated date of completion could be established as that for the average student.

Administer Criterion Tests

No changes required.

Score Tests, Analyze Student Performance

Instructions for scoring criterion tests will appear in the instructor's Guide developed to accompany the new instructional materials. Instructions for analyzing student performance, on tests and also on instructional items, will also be included in the Guides.

Determine Daily Diagnosis and Prescriptive Options

Instructors will need to monitor student performance and offer tutorial aid, counsel, or other advice on a daily basis. The Instructor's Guides provided with the instructional materials will offer guidance on diagnosis of student problems and determination of useful prescriptions for the individual student. The Student Report progress summary can also be used as a decision-making aid.

Update Student Records, Planning Reports

Instructors can send student records information to the administrative staff as is currently done. Student reports should be updated daily as a result of student-instructor interaction, instructor examination of student work, and test results.

Monitor Resources Effectiveness and Student Performance

School personnel whose activities are directed at course evaluation, student performance evaluation, and instructional materials revision will have more data available to them to use in these activities than is currently available. The Student Reports prepared by the instructor can be made available to them, as can the instructional materials used by the students. Students should therefore be encouraged to physically mark their answers to the programmed instruction items on the materials and to strike through incorrect answers rather than erase them. Other data desired by the evaluation staff should be identified and collected by the evaluation staff itself during the manual phase, to avoid overloading instructors with duties while they are learning their new roles.

Reduce and Analyze Performance Data, Analyze Course Materials, Analyze Job, Decide Revisions

Some amount of change in orientation of analysis activities will be required by individualization of portions of the IM course, particularly for analysis of course materials. Analysis can be directed at discovering which instructional frames, if any, are failing to teach satisfactorily. In the traditional course, this level of detail is usually not possible for course analysis and evaluation. The analysis staff can develop procedures for discovering and revising frames that do not meet established effectiveness criteria. Part Two of this report can be used as a guide to job analysis and development of materials should the job change or segments of the materials prove ineffective.

Develop/Revise Task Data, Objectives, Instructional Materials, Test Items, Prescriptive Rules, Instructor Support Materials

Instructional materials revision can be accomplished on an item by item basis as required. Part Two of this Technical Report can serve as a guide to preparation of new or revised instructional frames, test items, job data or objectives. Prescriptive rules and instructor support materials can best be revised as a result of ongoing instructor-evaluator coordination. A series of instructor-evaluator workshops is recommended, in which evaluators provide positive guidance on rules and materials modification, based on evaluation data and upon instructor experiences in the classroom.

Prepare and Output Evaluation Results Reports

No changes required.

APPENDIX D

VALIDATION STUDY AND DATA

VALIDATION STUDY AND DATA

APPENDIX D.

INTRODUCTION

The purposes of the Air Force tryouts were to: (1) verify the revised materials? and (2) to obtain additional data necessary to plan for a full scale implementation of the materials. The revised block IV materials were administered to a total of 57 students in three different groups by Air Force instructor personnel. Most of the 57 students were selected from a single shift (C) and inadvertently volunteers were permitted.

Data were gathered for each student on learning time per module, days to completion, end of block test score and aptitude scores. Student critiques were obtained anonymously at the end of the block from each student.

The tryout team consisted of three instructors. The tryouts were conducted in three rooms. One room was used for training and the other two for testing. (The second test room was used for block testing initially, but this practice was discontinued when it became evident that one room provided adequate test security.) Figure D-1 shows the layout of the training room.

The instructor oriented the students about the materials and procedures to be used and then permitted them to proceed. Figure D-2 is a decision logic chart of the process in this tryout. As each student finished a module, he was tested. Those who did not pass a module were given remedial training and were retested. At the completion of module eight, each student took the block test and was graduated. Had there been any failures, a washback or remedial process would have been used. Each student completed the critique after passing the block.

ANALYSIS and FINDINGS

The 57 students completed the block IV material in 45% of the normal block time. They achieved a mean block test score of 88.6%. All students passed the block test on the first try. Background and end of block test data are given in Table D-I. The distribution of days to completion of Block IV is given in Table D-2.

The 57 students achieved a mean time savings of 55%. This was somewhat better than that attained by the 20 students in the formative evaluation. The difference may be due to the improvements in the learning materials, the added experience of the instructors in managing the system, and;or differences among student abilities.

The critique data are given in Table D-3. The reactions of the students were highly favorable toward self-pacing and they found the materials easy to read. The reaction to the audiovisual material was quite favorable, but there were indications that versions of the audiovisuals used for review should be different from those used for advanced organizers. Because some of the students objected to using the same audiovisuals twice, the last group of students were given the option of skipping these in review. Only two of 16 students chose to skip the review.

Background data were obtained on an additional group of 100 students who were conventionally trained in Block IV in nearly the same time frame as the 57. The data for the 57 validation students, the 20 students in the formative evaluation, and the 100 other students were compared with respect to AQE and prior block scores. Table D-4 gives the means and standard deviations for the AQE[s and prior block grades for these groups. The 20 formative evaluation students and the 100 conventionally trained students do not differ markedly. If anything, the 20 have lower scores. The 57 validation students do have higher block scores and higher general and administrative qualification examination scores. The higher course scores probably have more meaning than the AQE scores and probably account for part of their increase in performance over the formative group.

The block IV scores and the learning times for the 57 validation students and the 20 students in the formative evaluation were compared. The validation group achieved higher scores in less time. Because the validation group had a better prior academic record as well as improved learning materials, the gains could be attributed to either the improvement of the materials or the willingness and ability of the individuals to learn. It is probably reasonable to expect that mean scores and times for large groups of inventory management students be between those for the 20 formative evaluation students and the 57 validation students.

The validation made use of separate rooms for training and testing. The instructors had no difficulty with this arrangement. In the learning room the instructor activity was more concentrated in the initial orientation and in interactions with students during the first two modules. This was partly to acquaint the students with the system and the importance of interacting with all of the materials. One instructor handled a room of 20 students with ease and indicated that a somewhat larger group size might be possible.

The activity level in the test room was such that one instructor could test students from two learning rooms. Thus three instructors could accommodate 40+ students without difficulty provided that they were given some relief for breaks. This instructor student ratio is no greater than conventional instruction.

There would appear to be no reason why this system could not be employed on a large scale if adequate audiovisual materials are provided. The precise layout of rooms and audiovisual devices would be a function of facility availability. Under some circumstances it might be preferable to locate audiovisual devices in one location, but it would appear that decentralized audiovisual devices is better.

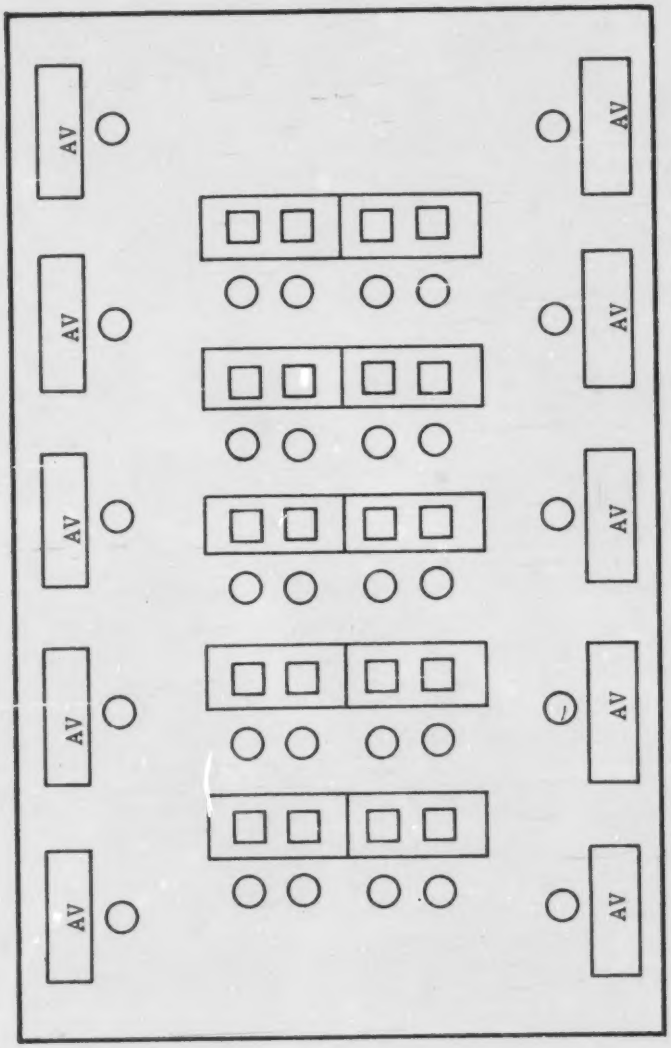

Figure D-1 Classroom Configuration

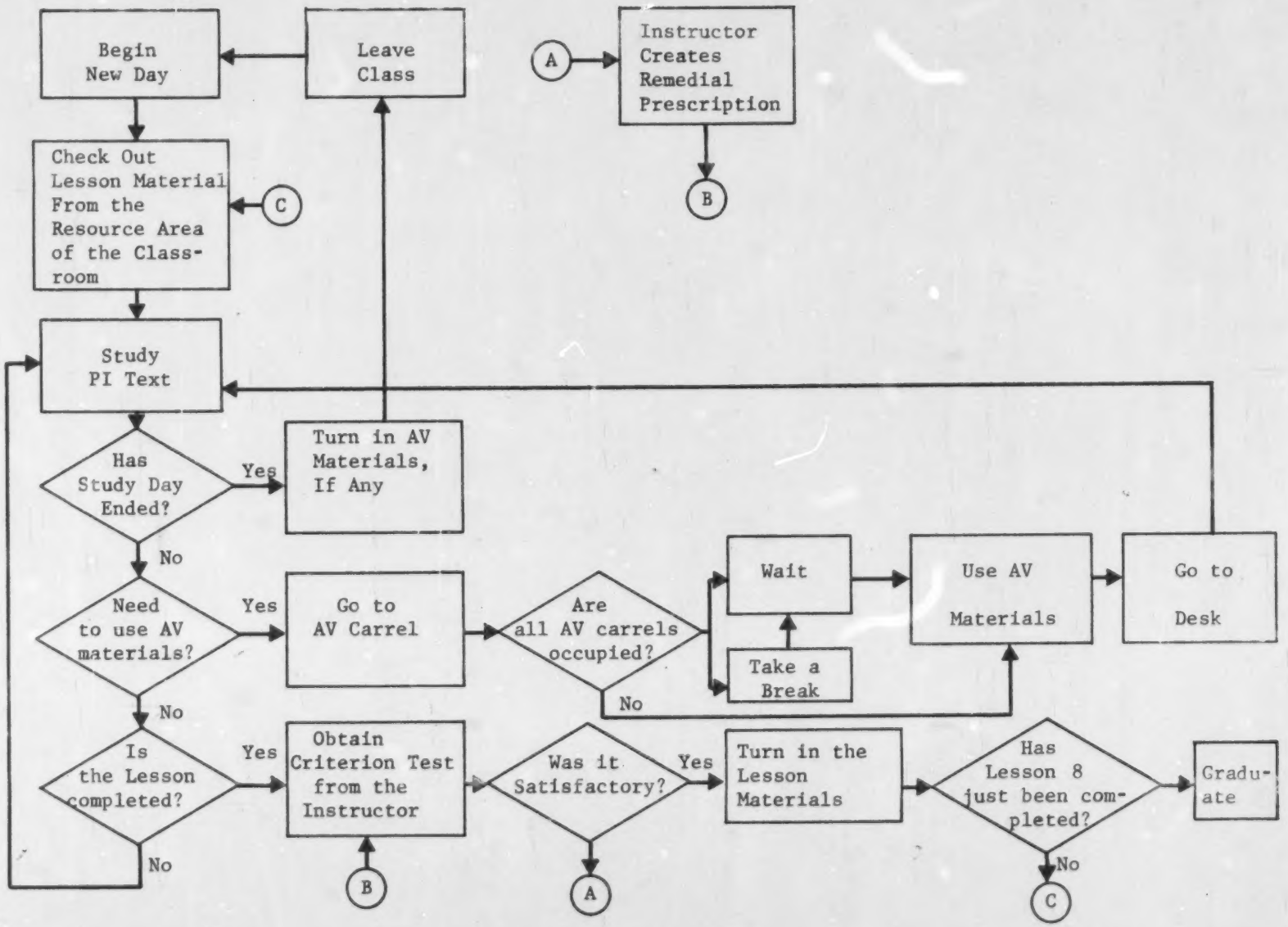

Figure D-2 Student Flow

Table D-1. Background and End of Block Test Data

	Gen.	Adm.	Mech.	Elect.	AFQT.	Block Test
1	60	60	45	45	33	92
2	60	85	60	65	38	94
3	95	80	30	65	54	96
4	70	65	50	65	36	90
5	80	70	90	90	91	86
6	85	75	70	60	80	96
7	55	80	40	30	60	92
8	65	80	45	65	82	80
9	75	70	55	80	78	92
10	80	60	65	70	60	96
11	60	95	45	55	38	88
12	45	95	35	40	36	90
13	25	60	40	40	42	92
14	60	40	65	60	76	84
15	75	70	45	55	49	94
16	65	80	80	50	48	92
17	50	60	20	35	34	86
18	50	80	30	65	58	88
19	55	60	55	25	33	78
20	55	60	55	25	33	78
21	65	80	30	30	34	88
22	45	70	30	30	67	88

	Gen.	Adm.	Mech.	Elect.	AFQT.	Block Test
23	60	70	50	55	58	84
24	70	65	70	60	91	90
25	60	80	30	40	59	100
26	65	80	65	65	49	86
27	80	88	70	65	83	92
28	80	80	55	55	62	94
29	55	60	25	50	52	86
30	85	85	70	85	89	90
31	95	95	95	95	98	100
32	80	70	35	50	80	94
33	90	85	45	90	91	80
34	75	70	35	35	58	80
35	65	80	55	45	-	80
36	50	65	50	15	-	78
37	65	70	55	65	-	76
38	75	90	55	80	-	78
39	75	65	65	60	-	70
40	-	60	45	-	-	82
41	-	-	-	-	-	86
42	-	-	-	-	-	86
43	45	60	45	60	44	98
44	60	65	10	25	54	88
45	70	90	60	60	81	90
46	75	85	55	55	60	78
47	95	70	65	75	72	94
48	70	60	55	70	33	94

	Gen.	Adm.	Mech.	Elect.	AFQT.	Block Test
49	80	85	80	65	60	100
50	90	85	75	95	91	88
51	75	70	40	70	66	92
52	95	90	95	95	99	94
53	60	60	25	55	59	80
54	75	80	60	60	74	98
55	75	95	45	65	36	80
56	90	85	95	90	-	98
57	85	60	60	70	-	96

TABLE D - 2

DAYS TO BLOCK COMPLETION	NUMBER OF STUDENTS COMPLETING BLOCK
3	2
4	28
5	23
6	3
7	1

TABLE D - 3

QUESTION	YES	(?)	NO
1. Do you like self-pacing?	54	1	2
2. Did material cover course content?	57		
3. Was the material easy to read?	55	2	
4. Were the tape-slides useful?			
a. Before	40	5	12
b. During	42	5	10
c. After	39	4	14
5. Did you learn better with this method?	43	6	8*

*The comments of six of these persons indicated they equated self-pacing with group pacing although their check mark was in the no column.

Table D - 4. Means and Standard Deviations

GROUP	AQE				Block Scores			
	Gen	Admin	Mech	Elect	BK I	BK II	BK III	BK IV
20 SDC								
$\bar{X}$	61.5	65.0	53.8	52.8	91.1	85.6	87.6	82.7
	12.3	9.7	8.6	14.6	4.0	4.7	8.8	8.4
57 Validation								
$\bar{X}$	69.5	74.3	53.0	59.2	95.8	90.3	93.2	88.6
S.D.	15.1	12.2	19.4	19.2	3.6	5.7	5.2	7.0
100 other								
$\bar{X}$	66.5	66.2	48.1	58.0	89.9	86.0	89.5	84.5
S.D.	13.5	15.5	18.9	15.5	6.8	9.2	7.2	-

STAGE 2 VALIDATION
STUDENT LEARNING TIMES:
LESSONS A-E, BLOCKS I-III

	Lesson	A				B				C				D				E			
	Student	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PI INTRO.		10	2	13	10	6	6	6	7	7	8	12	8	10	7	10	7	9	3	9	6
SLIDE INTRO.		5	7	3	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADV. ORG.		19	19	19	19	22	22	22	22	28	28	28	28	38	38	38	38	4	4	3	5
TEXT		48	45	1:50	50	2:37	2:21	2:39	2:13	1:13	1:26	1:38	54	3:42	3:12	3:15	4:05	1:17	1:23	1:17	1:17
BREAKS		10	10	10	10	30	30	30	30	10	10	10	10	40	40	40	40	10	10	10	10
REVIEW		0	0	0	1	19	31	3	1	3	0	2	6	0	2	11	3	0	0	5	3
EVAL.		9	13	9	11	1:05	41	35	25	18	11	14	13	26	31	46	31	10	13	11	9
PROV.		7	8	-	3	:34	29	28	27	-	0	-	-	27	22	19	30	4	5	3	5
TOTALS		(3 HRS.)				(12 HRS.)				(3 HRS.)				(8 HRS.)				(4 HRS.)			
TIMES		15	9	16	16	6	6	6	7	7	8	12	8	10	7	10	7	9	3	9	6
MATERIAL		1:17	1:14	2:19	1:20	3:48	3:44	3:34	3:06	1:54	2:04	2:18	1:38	5:00	4:32	4:44	5:26	1:31	1:37	1:35	1:35
TESTS		16	21	16	14	1:39	1:10	1:03	52	18	11	14	13	53	53	1:05	1:01	14	18	11	14
I SAVED		57	59	23	56	68	69	70	74	37	31	23	40	38	45	41	32	38	40	40	40
N I SAVED		49%				70%				34%				38%				39-1/2%			

Example

STAGE 2 VALIDATION
STUDENT LEARNING TIMES
LESSONS 1-8, BLOCK IV

Lesson	1				2				3				4				5				6				7				8			
Student	1	2	3	4	1	2	3	4	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8
PI INTRO.	8	12	3	5	-	-	1	5	10	7	6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SLIDE INTRO.	-	-	-	-	13	14	14	13	8	5	6	8	3	2	2	1	0	3	1	2	0	1	0	0	-	-	-	-	-	-	-	-
ADV. ORG	-	-	-	-	25	25	25	25	16	16	16	16	17	17	17	17	36	36	36	36	21	21	21	21	-	-	-	-	-	-	-	-
TEXT	1:00	1:26	1:01	43	4:07	2:36	4:23	4:01	2:06	1:53	2:13	2:00	1:50	1:12	1:27	1:40	1:21	1:01	1:09	1:17	1:19	57	1:20	1:22	36	44	57	1:01	17	21	18	19
BREAKS	10	10	10	10	30	30	30	30	20	20	20	20	20	20	20	20	10	10	10	10	10	10	10	10	10	10	10	10	-	-	-	-
REVIEW	4	0	8	0	2	3	5	30	13	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	-	-	-	-	-	-	-	-
EXAM.	-	-	-	-	20	23	15	35	13	11	18	21	5	10	13	12	12	12	9	11	13	12	12	11	14	11	13	5	6	5	5	4
PERF.	13	17	16	17	37	1:06	1:02	52	24	17	17	27	16	13	19	23	18	11	14	15	22	10	18	35	7	7	13	13	4	2	5	4

TOTALS	(3 Hours)				(9 Hours)				(9 Hours)				(6 Hours)				(6 Hours)				(6 Hours)				(3 Hours)				(3 Hours)			
INTRO.	8	12	3	5	13	14	15	18	16	12	12	20	3	2	1	0	3	1	2	0	1	0	0	-	-	-	-	-	-	-	-	-
MATERIAL	1:14	1:36	1:19	53	5:04	3:36	5:23	5:26	2:39	2:29	2:49	2:36	2:26	1:49	2:04	2:19	2:07	1:47	1:55	2:04	1:50	1:28	1:51	1:53	46	54	1:07	1:11	17	21	18	19
TESTS	13	17	16	17	57	1:29	1:17	1:27	37	30	35	48	21	23	32	35	30	23	23	26	35	22	30	46	21	18	26	18	10	7	10	8

% SAVED	63	47	56	70	41	58	37	36	71	72	69	71	59	70	66	61	65	70	62	66	69	76	69	69	74	70	63	61	91	88	90	89
M % SAVED	59				43				71				66.5				66				71				67				89.5			

Example

STAGE 3 VALIDATION
STUDENT LEARNING TIMES
LESSONS 1-8, BLOCK IV

STUDENT	1	2	3	4	5	6	7	8	TOTAL
1	1:10	7:30	3:50	2:40	2:48	2:58	1:15	:30	22:21
2	1:15	7:05	4:55	2:45	1:55	2:55	1:50	:55	23:35
3	1:35	9:35	4:15	2:00	3:17	3:53	2:15	:20	27:10
4	1:25	6:40	5:35	2:25	3:07	3:08	2:10	:27	24:57
5	1:15	6:25	4:10	4:20	1:15	2:46	1:39	:25	22:15
6	1:40	7:35	4:45	3:35	3:05	4:05	1:50	:35	27:10
7	1:10	6:30	4:10	3:30	2:45	4:05	2:00	:20	24:30
8	1:20	6:45	3:55	3:20	3:30	3:25	1:25	:40	24:20
9	1:10	7:05	4:25	2:45	3:10	2:48	1:47	:40	28:10
10	1:15	6:30	3:35	2:40	2:40	3:15	1:30	:20	21:45
11	1:25	6:25	3:45	2:40	2:30	3:10	1:35	:20	21:50
12	1:35	6:35	4:20	2:55	2:40	2:55	1:25	:35	23:00
13	1:18	6:30	3:50	3:15	2:30	2:35	1:25	:30	21:53
14	1:35	6:40	5:25	2:20	2:00	3:00	2:20	:30	23:01
15	1:40	8:40	4:30	3:45	2:45	5:05	2:40	:45	29:50
16	1:20	6:45	5:05	2:35	3:28	2:17	1:25	:55	23:50
17	1:25	6:45	4:55	2:30	2:25	2:45	1:25	:37	22:37
18	1:12	7:20	4:25	2:38	2:37	3:33	1:02	:30	24:17
19	1:15	8:00	4:25	4:25	2:20	3:05	1:05	:20	24:55
20	1:35	6:45	3:55	3:20	3:10	2:40	1:55	:35	23:55
	(3HRS)	(9HRS)	(9HRS)	(6HRS)	(6HRS)	(6HRS)	(3HRS)	(3HRS)	
MEAN TIME	1:23	7:06	3:35	3:01	2:37	3:13	1:38	:33	26:46
MEAN % SAVED	54	21	60	50	56	46	46	82	
	COURSE MEAN % SAVED 41								

Example

STAGE 2 VALIDATION
STUDENT PERFORMANCE SCORES:
LESSONS A-E, BLOCKS I-III

Lesson	ENABLING		CRITERION		Student	TOTAL		Lesson Mean Score
	No. Wrong	% Correct	No. Wrong	% Correct		Wrong	Mean % Correct	
	3	83	0	100	1	3	90	
A	1	94	1	92	2	2	92	87
	4	77	0	100	3	4	88	
	5	71	N/A	N/A	4	5	71	
Item N=	17		14			31		
	9	78	13	68	5	22	73	
B	9	78	4	90	6	13	84	86.5
	6	85	1	98	7	7	91	
	1	98	1	98	8	2	98	
Item N=	41		41			82		
	1	97			9	1	97	
C	0	100	N/A		10	0	100	88.8
	11	62			11	11	62	
	1	97			12	1	97	
Item N=	29					29		
	5	90	7	65	13	12	83	
D	4	92	1	95	14	5	93	88.4
	9	82	3	85	15	12	83	
	3	94	1	95	16	4	94.5	
Item N=	51		20			71		
	1	93	0	100	17	1	96	
E	0	100	0	100	18	0	100	97
	1	93	0	100	19	1	96	
	1	93	0	100	20	1	96	
Item N=	15		10			25		

Example

ENABLING CRITERION X

A LESSON BLOCK

TEST ITEM ANALYSIS

	1.1	1.2	1.3A	1.3B	1.5B	1.6C	2.2
1					EBDAC	EDA	
2							
3	B		7716420	(BLANK)			4
4		(BLANK)		AA	EBACD	HED	

	3.1	3.3	WRONG	%			
1	ABC		3	83			
2		AB	1	94			
3			4	77			
4	E		5	71			

Example

ENABLING CRITERION X

A LESSON

BLOCK

TEST ITEM ANALYSIS

	1A	1B	1C	1D	2A	2B	2C
1							
2							
3							8-11
4							

	2D	2E	3A	3B	3C	3D	
1							
2							
3							
4							

	WRONG	%		TOTALS WRONG	%		
1	0	100		3	90		
2	1	92		2	93	M = 87%	
3	0	100		4	88		
4	N/A	N/A		5/17	71		

Example

ENABLING CRITERION X

D LESSON

BLOCK

TEST ITEM ANALYSIS

	1.3	1.5	1.6	1.12	3.14	3.16	3.17
13		C		A			
14				A	BD		AEG
15	BV		A	A	BD	E	AEG
16			A	A			CEG

	3.23	4.6	4.7	5.1	6.2	WRONG	%
13		B	B	BCDAE		5	90
14		B				4	92
15	B		B		D	9	82
16						3	94

Example

ENABLING CRITERION X

TEST ITEM ANALYSIS

D LESSON

BLOCK

	1	12	14	15	16	17	20
13	MSI	D	C	B	DZ	(BLANK)	
14	MSI						
15	MSI		C				C
16	MSI						

	WRONG	%		TOTAL	N = 71		
13	7	65		12	83		
14	1	95		5	93		
15	3	85		12	83		
16	1	95		6	92		

N = 87.8

Example

STAGE 2 VALIDATION
STUDENT PERFORMANCE SCORES:
LESSONS 1-8, BLOCK IV

Lesson	ENABLING		CRITERION		Student	TOTAL		Lesson Mean Score
	No. Wrong	% Correct	No. Wrong	% Correct		Wrong	Mean % Correct	
1	N/A	N/A	6	71	1	6	71	77
			6	70	2	6	70	
			2	90	3	2	90	
			5	76	4	5	76	
Item N=			21			21		
2	9	67	12	65	1	21	66	72
	5	81	14	59	2	19	69	
	2	93	6	82	3	8	87	
	9	67	12	65	4	21	66	
	27		34			61		
3	2	91	2	93	5	4	92.5	85
	3	87	5	83	6	8	85	
	6	74	5	83	7	11	79	
	4	83	5	83	8	9	83	
Item N=	23		30			53		
4	4	78	2	91	5	6	85	88
	3	83	0	100	6	3	93	
	4	78	0	100	7	4	90	
	5	72	1	96	8	6	85	
Item N=	18		23			41		
5	4	86	0	100	5	4	93	89
	7	76	0	100	6	7	87	
	8	72	0	100	7	8	85	
	4	86	1	96	8	5	91	
Item N=	29		26			55		
6	13	64	2	95	5	15	80	79
	10	72	2	95	6	12	84	
	16	56	1	97	7	17	77	
	13	64	7	82	8	20	73	
Item N=	36		39			75		
7	4	80	4	64	5	8	74	70
	4	80	5	55	6	9	71	
	6	70	4	64	7	10	68	
	4	80	6	45	8	10	68	
Item N=	20		11			31		
8	0	100	4	67	5	4	79	87
	0	100	2	83	6	2	89.5	
	0	100	0	100	7	0	100	
	0	100	4	67	8	4	79	
Item N=	7		12			19		

Example

ENABLING CRITERION N/A / X

1 LESSON IV BLOCK

TEST ITEM ANALYSIS

	1	3	4	5	10	11	12B
21				ALLOWANCE	EA AUTHORITY	AUTHORITY NO APPROVAL	I
22	D	REQUIRED			E AUTHORI-ZATION ACTY.	(BLANK)	
23					EA AUTHORITY	ACTIVITY NO APPROVAL	
24		(BLANK)	(BLANK)	(BLANK)			

	12C	12D	12E	TOTALS WRONG	%		
21		E	C	6	71		
22	E		B	6	70		
23				2	90		
24	E		B	5	76		

Example

ENABLING CRITERION X

8 LESSON

IV BLOCK

TEST ITEM ANALYSIS

	WRONG	%					
25	0	100					
26	0	100					
27	0	100					
28	0	100					

Example

ENABLING CRITERION X

8 LESSON

IV BLOCK

TEST ITEM ANALYSIS

	3	6	7	8	9	WRONG	%
25	E		WRM ITEMS	D ONLY	B ONLY	4	67
26	E			C ONLY		2	83.5
27						0	100
28	E	B		BC	E	4	67

Example

STAGE 3 VALIDATION
STUDENT PERFORMANCE SCORES:
LESSONS 1-8, BLOCK IV (LARGE GROUP TRYOUTS)

Lesson	ENABLING		CRITERION		Student	TOTAL		Lesson Mean Score
	No. Wrong	% Correct	No. Wrong	% Correct		Wrong	Mean % Correct	
			2	90	1	2	90	
			2	90	2	2	90	
			4	80	3	4	80	
			0	100	4	0	100	
			1	95	5	1	95	
			1	95	6	1	95	
			0	100	7	0	100	
			1	95	8	1	95	
			1	95	9	1	95	
			3	85	10	3	85	
1	N/A		1	95	11	1	95	93
			2	90	12	2	90	
			2	90	13	2	90	
			1	95	14	1	95	
			0	100	15	0	100	
			0	100	16	0	100	
			3	85	17	3	85	
			1	95	18	1	95	
			1	95	19	1	95	
			1	95	20	1	95	
Item N=			21			21		

Example

ENABLING CRITERION X

1 LESSON

IV BLOCK

TEST ITEM ANALYSIS

	1	3	10	11	12	13	15
1	A						
2	C			REVIEW APPROVAL			
3	C				F	A	C
4							
5	C						
6	C						
7							
8	A						
9	A						
10	C				F		A
11	A						
12	A		ALLOWANCE				
13	A	A					
14	A						
15							
16							
17	C				D		
18	AC						
19				REQUIRED			
20	A						

Example

ENABLING CRITERION X

1 LESSON

IV BLOCK

TEST ITEM ANALYSIS

	16	WRONG	%				
1	A	2	90				
2		2	90				
3		4	80				
4		0	100				
5		1	95				
6		1	95				
7		0	100				
8		1	95				
9		1	95				
10		3	85				
11		1	95				
12		2	90				
13		2	90				
14		1	95				
15		0	100				
16		0	100				
17	A	3	85				
18		1	95				
19		1	95				
20		1	95				

Example

STAGE 2 VALIDATION
STUDENTS' ATTITUDE SURVEY
BLOCKS I-III

STUDENT	GENERAL	PI vs. TAI	AV	DIFFICULTY (Scale 1-10)	USE TEST KEY?
1	Liked	Preferred PI	1. No value until into the PI text. Then saw some benefit. 2. Very useful.	PI 3 TAI 6	No
2	Very good.	Preferred PI	1. Useful 2. Not of much use.	PI 3 TAI 5	No
3	Interesting, but would not like a steady diet of this.	Preferred PI	1. Not necessary but took on meaning as he progressed thru materials. 2. Essential.	PI 2 TAI 5	No
4	Too much time pressure, otherwise was real good.	TAI due to time pressure.	1. Useful 2. Useful.	PI 4 TAI 8	No
5	Confused at first jumping from one thing to another.	PI slightly better.	1. OK, but didn't learn anything. 2. Good.	PI 6 TAI 6	Yes
6	Not sure if liked it or not.	Didn't get the meaning of the acronyms and abbreviations.	1. Good. 2. Good.	PI 5 TAI 4	Yes
7	Interesting.	PI best of all.	1. Not useful. 2. Good, but not essential.	PI 3 TAI 5	No
8	Very interesting. A practical application.	PI for some courses but not all because you lose the fun of class interplay.	1. Helpful 2. Essential.	PI 3 TAI 4	Yes
9	If whole course was PI it would be boring.	About the same.	1. Useful. 2. Useful.	PI 4 TAI 6	No
10	Quite nice.	Preferred PI.	1. Beneficial. 2. Beneficial	PI 3 TAI 5	No

Example

STAGE 2 VALIDATION
STUDENTS' ATTITUDE SURVEY
BLOCKS I-III (Con't'd)

STUDENT	GENERAL	PI vs. TAI	AV	DIFFICULTY (Scale 1-10)	USE TEST KEY?
11	Great.	Preferred PI.	1. Useful 2. Useful	PI 3 TAI 8	No
12	Liked because the material sure sticks with you.	Preferred PI.	1. Not essential. Too much new material presented to comprehend. 2. Essential. Right pace. Cleared up gray areas.	PI 5 TAI 5	No
13	Particularly liked the self-paced aspect.	Liked PI.	1. Skip it. 2. It helped.	PI 5 TAI 6	No
14	Liked it.	Definitely PI.	1. Yes 2. Yes	PI 4 TAI 6	No
15	Liked the repetition.	Definitely PI.	1. Yes 2. Yes	PI 4 TAI 5	No
16	Liked it very much but would have liked to have taken notes.	PI much better.	1. Yes 2. Yes	PI 3 TAI 6	No
17	Good cartoons. Groovy.	PI best. Used PI for most of the courses	N/A	PI 3 TAI 5	Yes
18	Great	PI for all blocks	N/A	PI 3 TAI 6	N/A
19	Interesting. Excellent illustrations. Didn't like page turning.	PI for this and other lessons. Use a mixture for the whole course. Much better than USAF PI.	N/A	PI 2-3 TAI 5	No, but didn't realize the purpose of it.
20	Liked illustrations. Liked because could go faster. Too much filling out of forms.	PI for some lessons. This is best way to learn. Use mixture for the whole course. Much better than USAF PI.	N/A	PI 2 TAI 4	No

Example

APPENDIX E

COST ANALYSIS REPORT

COST ANALYSIS REPORT

SDC was asked to provide IM project cost data and to estimate potential reductions in costs for similar projects performed in a production configuration.

COST DATA

Man-hour data were extracted from project records for the IM course cost analysis. Direct man-hours were as follows for the project:

	Direct Man Hours
PHASE I	
Analysis of IM course	104
Selection of course segments	37
Prepare Technical Report	34
	175
PHASE II	
Task Analysis	332
Develop Learning Objectives	417
Develop Criterion Tests	156
Develop Media Selection Strategy	33
Develop Instructional Strategy	25
Prepare Technical Report	475
	1,126
PHASE III	
Develop Instructional Materials	1,668
Perform Pilot Study	210
Develop Management Strategy	63
Prepare Technical Report	103
	2,044
PHASE IV	
Evaluation & Revision	394
Prepare Technical Report	211
	605
Total Man-Hours	3,950

Materials and related costs were as follows for the project (in dollars):

	Dollars
PHASE I	
Editorial Support	37
Reproduction	33
TDY Travel	493
	563

	Dollars
PHASE II	
Editorial Support	76
Reproduction	107
TDY Travel	246
	429
PHASE III	
Editorial Support	980
Reproduction - 13 Lesson Modules	173
TDY Travel	402
Equipment (Wollensak Cassette Recorder)	240
Art Supplies & Tape Cassettes	286
Slide Development (545 - 35mm)	3,501
	5,582
PHASE IV	
Editorial Support	729
Reproduction	2,874
TDY Travel	2,614
Black Slide Trays (180)	324
35mm Duplications of 545 (29 sets)	4,794
Visual Arts	340
Tape Cassettes Duplications of 11 (29 sets)	1,058
	12,733
Total Dollars	19,307

PRODUCTION CONFIGURATION ESTIMATION RATIONALE

SDC was asked to estimate the reduction in costs that might occur if a project such as the IM project was performed in a production configuration rather than in a research and development configuration. A rationale to account for cost differences was therefore prepared. Because SDC did not manage the IM project in a true R&D configuration, being production-oriented to a considerable degree, two sets of cost reduction assumptions were prepared for the estimation task. The first set of assumptions would be appropriate for estimating production configuration cost reductions from R&D configuration

costs. The second, which was actually used to make estimations for this report, is appropriate for estimating production configuration cost reductions from SDC's cost records. The three types of configurations can be compared as shown in Table E-1.

Table E-1. Configuration Comparison

Comparison Factors	R&D Configuration	SDC's Configuration	Production Configuration
Amount of specialization or project personnel	Either Very Low or Very High	Medium	High
Diversity of skill and salary levels of project personnel	Low Low	Medium Medium	High High
Amount of in-house production equipment utilized on project	Low	Medium	High
Volume of related business ongoing, over which project personnel, equipment and facilities are shared	Low	Medium	High
Proportion of methodologies, rationales, and strategies required to be developed especially for project work	High	Medium	Low
Amount of job aids available to guide project personnel	Low	High	High

SDC believes that cost reductions would be considerable in a changeover from an R&D configuration to a production configuration, given that the following assumptions hold:

- In an R&D configuration, a major manpower-related cost is associated with design and development of special methodologies, strategies and rationales for producing project outputs. An example would be development of a method for selecting methods and media for each lesson element. In a production configuration, existing methodology is merely adapted for use in a specific project, and job aids, such as forms, checklists, and handbooks are available, reducing direct man-hour costs by an estimated 20%.
- In an R&D configuration, principal researchers, with excellent academic credentials and years of research experience, often perform the bulk of the project work themselves, farming production work out-of-house and perhaps using relatively inexperienced personnel for the simplest tasks. In a production configuration, each project member is specialized and his skill and salary level is appropriate to the subset of tasks he performs. All project tasks are done in-house, utilizing in-house personnel, equipment and facilities, the costs of which are shared with other similar projects. Estimated man-hour cost reductions in the production configuration are 10%, due to 1) a reduction in the number of high skill and salary level personnel required, 2) the somewhat lower total number of hours required for specialized production personnel to perform lower level tasks in comparison with use of inexperienced personnel or students, and 3) the work-load balancing made possible by a high volume of related projects. Estimated cost reductions for materials in the production configuration are 25%, based primarily on the fact that audiovisual materials processing and reproduction costs are less in the production configuration, being incurred in-house, and also that equipment costs are shared over many similar projects.

Cost reductions in a changeover from SDC's production-oriented configuration to a true production configuration are less than can be obtained in a changeover from a true R&D configuration. The following assumptions must be used in making cost reduction estimations:

- No man-hour costs can be attributed to design of special methodologies for performing project tasks, since existing methodologies were used instead, as they would be in a production configuration. Costs of adaptation of methodologies, strategies, and rationales for the IM project were about the same as would be incurred in a true production configuration.

- Reductions in man-hour costs due to the possibilities for increased personnel specialization and diversity of skill and salary levels in a production configuration are small, because SDC has adopted a production-oriented stance toward manning of projects like the IM project.

- Instructional materials production costs would be somewhat less in a true production configuration with a high volume of related work. It is estimated that as much as a 25% saving would be possible, due to differences in volume-buying costs of equipment and material and to methods of accounting for production and processing charges.

ESTIMATES OF REDUCTIONS IN COSTS

Estimations of reductions in costs for specific items are listed in Table F-2, which applies to cost differences in the SDC configuration versus a production configuration. Percentages represent reductions in dollar costs throughout the table.

Table E-2. Cost Reduction Estimates

Cost Element	Reduction in Production Configuration
Phase I	
Analysis of IM Course	0%
Selection of Course Segments	0%
Prepare Technical Report	0%
Editorial Support	0%
Reproduction	10%

Cost Element	Reduction in Production Configuration
Phase II	
Task Analysis	0%
Develop Learning Objectives	0%
Develop Criterion Tests	0%
Develop Media Selection Strategy	0%
Develop Instructional Strategy	0%
Prepare Technical Report	60% (part two not required in production configuration)
Editorial Support	5% (tech. report shorter)
Reproduction	20% (tech. report shorter)
TDY Travel	100% (facility located at school)
Phase III	
Develop Instructional Materials	5% (more specialization)
Perform Pilot Study	5% (lower level personnel)
Develop Management Strategy	0%
Prepare Technical Report	20% (part two not required)
Editorial Support	5% (tech. report shorter)
Reproduction	20%
TDY Travel	100% (if facility located at school)
Equipment (Cassette Recorder)	90% (cost shared over several projects)
Art Supplies and Cassettes	10% (high volume buying)
Slide Development	25%
Phase IV	
Evaluation and Revision	10% (lower level personnel)
Prepare Technical Report	50% (part two not required)
Editorial Support	5% (tech. report shorter)
Reproduction	20%
TDY Travel	100% (if facility located at school)
Black Slide Trays (180)	10% (high volume buying)
Duplication of Slides	25%
Visual Arts	20%
Duplication of Tape Cassettes	30%

The estimates shown in Table E-2 would result in an overall saving of about 19% in dollars, if no travel were necessary and if Part Two of the Technical Report were not required. If these two cost elements were required, then cost savings would be only 7-1/2%.